THURSDAY, NOVEMBER 25, 1915.

SCIENCE AND THE PUBLIC.

IN his "Ode on the Coronation of King Edward the Seventh," William Watson wrote of England these notable lines:—

> For now the day is unto them that know,
> And not henceforth she stumbles on the prize;
> And yonder march the nations full of eyes.
> Already is doom a-spinning. . . .

To some of us who were painfully aware of the apathy of British statesmen and of the British public towards the claims of science for truer recognition, these words, when they were uttered thirteen years ago, came as the words of a seer. The fallacy of misplaced optimism, that England would somehow "muddle through," was then rampant; England had always stumbled on the prize of success; chance might be trusted that she would stumble on it again. Ignore the men who know; distrust the expert; let us go on with our muddling; let us play golf and shoot our pheasants, and let other nations scheme, and sweat, and cultivate science! It seemed at one time as though some attempt was being made to remedy this national apathy. The creation by Parliament, half a century back, of a Science and Art Department, suggested at least an amelioration of the old bad state of things; and efforts were made—hopeful efforts, and not unsuccessful in a way—to foster the teaching of science in the older universities and build up newer institutions on a basis of its full recognition. These efforts, though they have by no means failed, have not, however, brought about public recognition to a degree commensurate with the national need, or comparable with the recognition accorded to science in Continental nations, including the central European empires with which we are now in armed conflict.

It is unfortunately only too well known to scientific men that for more than a generation past the trend of public opinion, at least as represented by politicians, statesmen, departmental officials, municipal authorities, and including even the heads of many great industrial and commercial undertakings, has been to ignore the position of science in the fabric of civilisation, and to treat the development of science as though it were a matter of little moment to the national welfare. It has required nothing short of the most terrible war of all time to awaken the nation to its slackness in many things. Indeed, the nation has as yet not begun either to realise how dearly it is paying for its neglect of science, or to reconstruct on a scientific basis its politics, its statesmanship, its commerce, its education, its civil and industrial administration. Distrust of the expert, of the man who has made it his business to know, is still the fashionable, if not the prevalent attitude towards men of science. The public which purchases every morning and evening the halfpenny journals, and swallows the pabulum which they provide, is the same public which elects our Parliamentary representatives and rules most of our national institutions. Occasionally the daily papers deign to insert a paragraph of what they think to be scientific news. If the public prefers its sensational tit-bit of science-gossip, culled from the pamphlet of some pseudo-scientific charlatan and served up hot by an anonymous paragraphist, to more sober and informing articles written by men whose authority is indisputable, the public has itself to thank. Editors and sub-editors do not know enough science to suppress the twaddle; and, consequently, blunders which would be thought amazing if perpetrated in a like fashion in the domains of literature or art or history, are put into gratuitous and harmful circulation.

In political circles the same indifference to science prevails. Apart from the handful of university members, which includes Sir Joseph Larmor and Sir Philip Magnus as the sole representatives of the most neglected branch of human activities, there is not one scientific man in the roll of the House of Commons. In the House of Lords science is indeed represented by two hereditary peers, Lord Rayleigh and Lord Berkeley; but there have been no scientific men called to the peerage since the deaths of Lord Kelvin, Lord Lister, and Lord Avebury. The esteem in which science is held may be measured by the suggestion in Lord Dunraven's scheme for the reform of the House of Lords, that in the future it should consist of 400 members, whereof *two* should represent art, literature, and science! When this amazing proposition was put forward not one voice cried out in protest against this insult to science; it was a much more important question whether the bishops shall continue to be peers. In less august circles the same astonishing contempt for the claims of science is apparent. Shortly before the death of King Edward VII. the Lord Mayor of London gave a luncheon to our present monarch, then Prince of Wales, and to the Elder Brethren of Trinity House. Distinguished members of the Services, as well as Parliamentarians, were of course invited, and there were lawyers, artists, play-actors, and stock-

brokers; but not one engineer, chemist, or man of science: at least the newspapers reported none as present. His Royal Highness did not notice the omission; it was an utterly trivial incident, of course. Straws show which way the wind blows.

Not one of the headmasters of the great public schools is a man of science, and very few of the heads of houses in the old universities; though the recent selection of a zoologist and a botanist to such posts of dignity at Cambridge may be a timely concession. If the headmasters and heads of houses are by training and tradition out of sympathy with science, is it astonishing that under-masters and schoolboys, as well as undergraduates, grow up ignorant of scientific method, and despise that of which they are ignorant? Worst of all, in those departments of our schools where science is admitted, it is treated as an inferior study. No doubt our public school system turns out many admirable cricketers and a few scholars; but of the living men who have made their mark in science, how few can thank the public schools for that achievement? At every general election the public—to judge from the Press—is keenly anxious to know how many of the members of the House were reared at Harrow, and how many at Eton. But no one cares how many Fellows of the Royal Society, or members of the Institution of Civil Engineers, or Fellows of the Institute of Chemistry are from Harrow or Eton.

We now suddenly discover in the cataclysm of a terrible war, not only that science has been at a discount in the organisation of the army, but that our industrial and commercial life is disorganised and crippled by the same elementary disregard. Nearly half a century ago Disraeli warned us that the commercial prosperity of a nation might be measured by the prosperity of its chemical manufactures. He was laughed at as though his dictum had been a joke. But it ceases to be a matter for joking when the neglect of science leads to the disappearance of whole branches of those trades that are concerned with the technical applications of chemistry or physics or metallurgy. The loss of the dye-stuff industry; the decay of several branches of the glass industry; the ever-increasing pressure in the metal industries, in the varnish industry, in the watch and clock industry, in innumerable branches of the engineering industries, are serious indications. They are symptoms that something has been rotten in the administration of the State. But they have not occurred without serious warning. Sir Norman Lockyer's weighty British Association address, Professor Perry's trenchant "Neglect of Science," Lord Haldane's earnest pleas for the improvement of education in the interests of national efficiency, all pointed the same moral: *if you neglect science, you do so at your peril.* But these warnings fell largely on deaf ears. The assistance given by Government to the promotion of science has been largely a sham supplemented by a few doles. Government has given, it is true, a large sum for the establishment of the National Physical Laboratory. But the German Government gives three times as much, and the United States Government four times as much, for their corresponding national institutions.

In its wisdom, the Government—not the present one—has merged the Science and Art Department in a Board of Education, a Board which never meets, under successive Ministers of Education, who, however able they may have been, have not in any case been men of eminence in science. In the Army there is unconcealed contempt for and hostility to the opinion of any civilian expert; he is lower than any mere gunner. Even the military engineer is set down as a mere sapper. In the Navy things are not quite so bad, though it required years of agitation to secure even a partial recognition for the naval engineer. Had science been despised in the Navy as it is in the Army, where would Britain have been to-day? In political and financial circles the contempt is complete; science neither goes out vote-catching, nor panders to Stock Exchange operations. It is therefore of no importance. Always, and ever, and again, science is despised and ignored.

If the public, the nation, and its appointed rulers display such blindness, is it wonderful that national interests, civil as well as military, industrial as well as agricultural, suffer grievously when forced to compete with nations sedulously trained in the cultivation of science?

> And yonder march the nations full of eyes.
> Already is doom a-spinning.

TWO MORE BANTU BOOKS.

(1) *A Concise Kaffir-English Dictionary.* By J. McLaren. Pp. xv+194. (London: Longmans, Green and Co., 1915.) Price 3*s.* 6*d.*

(2) *A Manual of the Chikaranga Language.* By C. S. Louw. Pp. x+397. (Bulawayo: Philpott and Collins, 1915.) Price 12*s.* 6*d.* net.

(1) IT is curious that so many industrious persons have issued, in the course of the last eighty years, one-sided dictionaries of Kafir (Xosa) dialect of the great Zulu language, and that no one that I know of has published a *full*

English-Kafir dictionary. Such works as those under review are, of course, valuable, but they would be twice as useful if, in addition to Kafir-English, an English-Kafir section was added. English-speaking people in South Africa will not find the work now under review of as much use or importance as philologists, because it will need endless searching to find therein the equivalent of some English word which they wish to translate into Kafir.

Mr. McLaren, in compiling the work under review, acknowledges his great indebtedness to the previously published monumental dictionary by Dr. Kropf, and to the great Zulu Dictionary of Bryant. Unfortunately, like most writers on the Kafir dialects, he adopts the South African orthography, which is devised without any regard to the existence of other languages in the world requiring to be spelt phonetically, and which ignored most of the suggestions made by Lepsius in his standard alphabet. To express the three or the four clicks used in the South African Bantu the letters *c*, *q*, and *x* are borrowed, oblivious of the fact that all are required and have long since been used in other phonetic systems to express the English ch, the Arabic ج, and the Greek χ. The Arabic guttural ق is of such common occurrence all over the world in languages too numerous to catalogue, that the symbol *q* is required for its expression, and is made use of more logically since this Semitic letter, borrowed by the Greeks and the Romans, had in Phœnician almost certainly the sound of the Arabic ق. In my own work on phonetic spelling, and in my study of the Bantu languages, which is gradually being printed by the Oxford University Press, I have been obliged to devise special type to indicate the clicks, because the symbols offered by Lepsius were too confusing to the eye when written or printed.

The term "Kafir" is, of course, exasperating to the logical mind, as it is nothing more than the Arab term "unbeliever," but it seems to have become permanently established in South Africa, and cannot be set aside—though why linguists like Mr. McLaren should wish to spell it with two f's instead of one is what I cannot understand. There is no general term other than Kafir to include the closely allied western dialects of the Zulu species—Xosa, Tembu, Pondo, Pondomisi, Xesibe. The other well-marked dialects on the east and north are Zulu and Swazi. The "Angoni" of Gazaland (reaching also to Nyasaland) is perhaps a fourth sub-species. To those who cannot afford the big, heavy, and expensive (but most valuable) Kafir-English Dictionary of Dr. Kropf, the work under review will be useful, as it is light, compact, clearly printed, and priced at only 3*s*. 6*d*.

(2) Chikaranga is, as Mr. C. S. Louw informs us in his preface, the language spoken by the natives of Mashunaland in southern Rhodesia. It is a language divided into several well-marked dialects, and the general name of these is more correctly spelt (as it is pronounced) Karaña. The Karaña language is the southernmost member of that far-spread Nyanja group, which extends over the Shire basin half-way up Lake Nyasa, and includes most of the tongues of the lower Zambezi and of the Zambezi valley as far west as the vicinity of the Victoria Falls. The book under review is quite the best manual as yet published on this important speech. It consists of a grammar, exercises, and a copious vocabulary, virtually a dictionary, English-Karaña and Karaña-English. It is published by Philpott and Collins, Bulawayo, and it is a pity that no indication is given of any London agency, for the work is sure to be in request in that ever-widening circle of Bantu students, not only for its philological interest, but because a knowledge of Karaña is of really great importance to those who are proposing to settle and work in southern Rhodesia and adjoining portions of Portuguese south-east Africa.

H. H. JOHNSTON.

FINITE DIFFERENCES FOR ACTUARIES.

Elements of Finite Differences, also Solutions to Questions set for Part I. of the Examinations of the Institute of Actuaries. Second edition. By J. Burn and E. H. Brown. Pp. iii+289. (London: C. and E. Layton, 1915.) Price 10*s*. 6*d*. net.

THE first edition of this work, which is intended for students preparing for the first examination of the Institute of Actuaries, appeared in 1902. The present edition only differs from its predecessor in the addition to part i. of an alternative demonstration of Lubbock's formula for approximate summation, and of three chapters dealing with Stirling's Interpolation Formula, Interpolation for functions of two variables, and Interpolation of inverse functions.

The first two chapters give a clear and straightforward exposition of the elementary processes and formulæ. In the chapter on Interpolation, the usual Finite Difference methods and that of Legrange are given. In the case of a function which is given for *n* non-equidistant values of the variable, it is suggested that a possible method of procedure is to assume

$$U_x = A + Bx + Cx^2 + \ldots + Dx^{n-1}.$$

This leads to very heavy work which could have been avoided by taking

$$U_x = A + B(x-a) + C(x-a)(x-b) + \dots$$

where a, b, . . . are the values of x for which the function is given. This is actually given in a later chapter, but its use in this connection is not mentioned. The section on Two-Variable Interpolation seems out of place, in view of the introduction of a chapter dealing entirely with this branch of the subject. The short chapter on Central Differences, which is practically a reproduction of the obsolete, cumbersome, and imperfect demonstration given in the Institute of Actuaries' Text-book, part ii., might well have been dropped, as the work is redone by a better method in the chapter on Stirling's Formula. As is shown in the latter chapter, the formulæ follow at once from assumptions of the form

$$U_x = A + Bx + Cx(x-1) + D(x+1)x(x-1) + \dots$$

The authors, however, make their demonstrations unduly long by obtaining U_0, ΔU_0, $\Delta^2 U_{-1}$, . . . by detailed expression of U_0, U_1, U_{-1}, . . . in terms of A, B, . . . If U_x had been written in the form

$$A + Bx + \frac{C x^{(2)}}{2!} + \frac{D(x+1)^{(3)}}{3!} + \dots$$

the difference of U_x for all values of x could have been written down without the tedious arithmetic which is employed. Two pages are devoted to the C.D. expansions of U_x in which the leading terms are $U_{\frac{1}{2}}$ and $U_{-\frac{1}{2}}$ respectively. All this is quite unnecessary, as the formulæ can be deduced from those already obtained by writing

$$U_x = U_{\frac{1}{2}+(x-\frac{1}{2})} \text{ or } U_{-\frac{1}{2}+(x+\frac{1}{2})}$$

It is to be regretted that the opportunity was not taken to revise the chapter on Summation. The function is frequently written before the operator, and we have such surprising statements as

$$U_{a+x} = U_a(1+\Delta)^x,$$

$$U_a + U_{a+1} + \dots + U_{a+n-1} = U_a\left\{n + \frac{n(n-1)}{2!}\Delta + \dots\right\}$$

and the operators are spoken of as the *coefficients* of U_a. The introduction of the alternative so-called demonstration for Lubbock's formula is unfortunate, as the symbolical method employed is quite unsound, and may be mistaken by students for a proof. The chapter on Interpolation of Inverse Functions, consisting mainly of two examples, is unnecessary, and the examples might have been incorporated with those on Legrange's formula.

Three-quarters of the book (parts ii. to iv.) are taken up with solutions of questions set in the first examination of the Institute of Actuaries between the years 1887 and 1902. The questions include Permutations and Combinations, Binomial Theorem, Probabilities, and Elementary Finite Differences. The solutions are instructive, but those on Finite Differences follow too closely the methods of algebra text-books instead of the neater methods of Finite Differences. The incorrect solution to problem 212 given in the first edition is repeated, and the solution to problem 202, giving the expression of $U_0 + U_1 x + U_2 x^2 + \dots$ in terms of differences of U_0, should have been incorporated in the chapter on Summation. It would have been more useful to the students for whom the book is intended if solutions of questions from recent examination papers of the Institute of Actuaries had been given, as the syllabus now includes the elements of Differential and Integral Calculus.

PRACTICAL AND APPLIED CHEMISTRY.

(1) *Practical Physical Chemistry*. By Dr. A. Findlay. Third edition. Pp. xvi + 327. (London: Longmans, Green and Co., 1914.) Price 4*s*. 6*d*. net.

(2) *Practical Physical Chemistry*. By J. B. Firth. Pp. xii + 178. (London: Methuen and Co., Ltd., 1915.) Price 2*s*. 6*d*.

(3) *Volumetric Analysis*. By A. J. Berry. Pp. 137. (Cambridge: At the University Press, 1915.) Price 6*s*. 6*d*. net.

(4) *A First Course in Practical Chemistry for Rural Secondary Schools*. By W. Aldridge. Pp. xii + 122. (London: G. Bell and Sons, Ltd., 1915.) Price 1*s*. 6*d*.

(5) *Dyestuffs and Coal-Tar Products: their Chemistry, Manufacture, and Application*. By T. Beacall, Dr. F. Challenger, Dr. G. Martin, and Dr. H. J. S. Sand. Pp. vii + 156. (London: Crosby Lockwood and Son, 1915.) Price 7*s*. 6*d*. net.

(1) and (2) THE third edition of Prof. Findlay's "Practical Physical Chemistry" contains a description of several new experimental methods, especially in connection with the determination of vapour-densities, surface-tension by the drop method, molecular-weights, solubility and hydrolysis of salts by conductivity-measurements, and the measurement of decomposition and of ionic-discharge potentials. The new edition retains all the merits which have long been recognised in its predecessors.

Mr. Firth's book is of a similar type to Prof. Findlay's, and seems to indicate that a standard course of physical chemistry has now been developed, and is being followed with very little modification in a number of different centres. The coincidence in this case extends not merely to identical illustrations of standard apparatus, but even to the inclusion in each volume of a picture

of a tabloid-press. The general character of the course is now too well known to call for detailed description.

In the opinion of the writer, the time is ripe for a revision of the optical experiments described in books of this type. The Continental form of the Pulfrich refractometer suffers from a seriously-defective form of water-jacketing, and might with advantage be replaced (in the text-book as well as in the laboratory) by the newer English instrument, which has been improved greatly in this respect. Similar statements may be made in reference to polarimetric apparatus, in which the English makers now enjoy a marked superiority, which might well find acknowledgment in books such as those now under review. The time is also ripe for recognising the great technical importance of the newer sources of monochromatic light, and the advantages they possess over those formerly in use. The introduction of lithium into the sodium flame and of a globule of mercury into a warmed hydrogen vacuum-tube provide, for use with a refractometer, a series of four lines which is much superior to the traditional series CDFG, which has come down to us from the period when sunlight was still the chief illuminant for optical experiments; the fact that the instrument will need to be calibrated for these four wave-lengths (*e.g.*, with a crystal of quartz) is a real advantage from the point of view of the training of the student. For polarimetric work the enclosed mercury arc, which has now almost displaced the sodium flame, both in technical and in scientific laboratories, is ripe for description in the text-books; and it ought to be followed very soon by a description of Dr. Sand's enclosed cadmium arc, the brilliant invention of an English worker, which promises to revolutionise all those branches of optics which depend on the utilisation of powerful sources of monochromatic light. It is curious that both authors should be content with jacketed polarimeter tubes in which only about three-quarters of the liquid is under the direct control of the circulating water.

(3) Mr. Berry's "Volumetric Analysis" represents a distinct advance upon most of the smaller books on the subject, though its advantages are largely neutralised by the very high price which is charged for a volume of less than 140 pages. The method of treatment is more scholarly than is usual in a small text-book, and the inclusion of a chapter on the "Theory of Indicators," based on Mr. Tizard's well-known report, affords welcome recognition of the scientific aspects of the subject. If issued at half the present price the book could be commended heartily for general use in the many laboratories in which volumetric analysis is now taught.

(4) Mr. Aldridge's book is little more than a skeleton, on which a useful course of elementary chemistry may be built up; but it gives the impression that the author is alive to the various educational features that may be embodied in such a course, and the suggestions which he makes should be of real value to other teachers who have not had so long an experience in work of this kind. Specially welcome is the stress which he lays on the full description written by the pupil of his experiments and observations, a description to be written in pencil at the laboratory bench, but written neatly, arranged logically, and expressed in the best English which the boy can command. Such an exercise is certainly better than the barren attempt to induce a boy to express in a formal essay pious opinions on a subject of which he has no special knowledge, and in which his interest is often non-existent.

(5) Dr. Martin's book on "Dyestuffs and Coal-tar Products," issued as the first of a series of manuals of chemical technology, is reprinted with additions from vol. i. of his well-known book on "Industrial and Manufacturing Chemistry," and does not, therefore, call for a detailed review. The sections reproduced deal with the coal-tar industry, synthetic colouring matters, natural dyestuffs, dyeing and colour-printing, inks, saccharine and other sweetening chemicals, modern synthetic drugs, and photographic chemicals. The reproduction of these articles is very opportune at the present time, and will be generally welcomed. T. M. L.

OUR BOOKSHELF.

The Principles of Agriculture through the School and the Home Garden. By C. A. Stebbins. Pp. xxvi+380. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 4*s.* 6*d.* net.

"DAISIES growing a girl" is the title of the frontispiece of this volume and aptly illustrates its aim. Through practical work in garden and classroom juvenile cultivators are led towards a broad outlook as members of the community. Problems of the garden lead, on the one hand, to problems of the farm, market, and finance, and on the other hand, to those of the home, city, and public health. By their own experience the children learn, not only how seeds germinate and where mosquitoes breed, but also how, on a plot of garden ground, each can take his share of responsibility as a citizen. There are score cards for everything from potatoes to personal hygiene. Even the latter the child scores for himself, and his record counts one-half for his own promotion from class to class in school! Such is "school-gardening" as actually carried out in the Western States to-day.

We wish that every school teacher in this country could read this volume. Every page is

exhilarating reading, and the pictures not only illustrate the text, but drive home the lesson, sometimes with irresistible force. To the author science is the basis of healthy life and successful industry. The child is led to ask and answer questions; his appetite is whetted, but never satiated, and he is taught to look for scientific guidance to the State Experimental Station or the proper Government Department, the doors of which (in America) are always open to the inquiries even of children. The school has its proper relation, in some ways almost subordinate, to home and environment in the education of the child. If dollars are often mentioned, it is because they are a measure of the success of each worker in contributing to the well-being of the community. Among some pithy maxims in the preface the following may be commended to teachers: "Do not let such matters as an expensive fence prevent gardening. Get along without the fence. A radish more or less will cut no figure."

Is Venus Inhabited? By C. E. Housden. Pp. 39. (London: Longmans, Green and Co., 1915.) Price 1*s.* 6*d.* net.

THE uninhabitability of most of the worlds of our system—the sun and moon, Mercury, and the giant planets—is practically assured. Our nearest neighbours, Venus and Mars, remain doubtful; speculation as to life on these worlds is natural and quite legitimate, provided it does not claim greater assurance than the evidence warrants.

Mr. Housden is an enthusiastic adherent of Prof. Lowell's views, and has already written "The Riddle of Mars," supporting the artificial nature of its canal system. He now deals with Venus, assuming the 225-day rotation, and the reality of the spoke-like markings drawn by Lowell. The great heat on the day hemisphere causes convection currents, which deposit the moisture as ice and snow just inside the dark hemisphere, whence some of it is supposed to flow in the form of glaciers into the day hemisphere. He supposes that the zone of this hemisphere where the sun is low is inhabited by intelligent beings, who pump the water back along several conduits (Lowell's spoke markings). He claims to reconcile the contradictory conclusions (1) that the 225-day rotation would precipitate all moisture on the dark side, and (2) that the bright side is largely cloud-covered. But he has built a large superstructure on a slender basis of observed fact.

The Romance of the Spanish Main. By Norman J. Davidson. Pp. 313. (London: Seeley, Service and Co., Ltd., 1916.) Price 5*s.*

THIS "Record of the most daring deeds of some of the most famous adventurers, buccaneers, filibusters, and pirates in the western seas," as the sub-title describes the volume, will fascinate boy readers and incidentally teach them much history and a helpful amount of geography, especially if they will trace the various voyages described on a good map. The book is well illustrated and attractively bound.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Pre-Columbian Representations of the Elephant in America.

MORE than sixty years ago, in his "Incidents of Travel in Central America," Stephens directed attention to an elaborately carved "idol" at Copan, and stated that "the two ornaments at the top look like the trunks of elephants, an animal unknown in that country."

No one who looks at the accompanying tracing, which I have taken from Dr. A. P. Maudslay's magnificent atlas of photographs and drawings of the Central American monuments (Godman and Salvin's "Biologia Centrali-Americana," Archæology, plate xxxiv.), should have any doubt about the justification for Stephens's comment. Moreover, the outline of the head is so accurately drawn as to enable the zoologist to identify the original model for the design as the Indian species of elephant. It is equally clear that the sculptor of the monument was not familiar with the actual animal, for, according to Drs. Maudslay and Seler, he has mistaken the eye for the nostril, and the auditory meatus for the eye, and represented the tusk (note its relation to the lower lip) and the ventral surface of the trunk in a conventionalised manner, without any adequate realisation of the true nature of the features he was modelling.

Certain early Chinese craftsmen adopted a similar convention in their representation of the elephant's tusk and the ventral aspect of the trunk (see, for example, "Chinese Art," vol. ii., Fig. 55, Victoria and Albert Museum Handbooks).

Having converted the auditory meatus into an eye the sculptor had to deal with the auditory pinna, the meaning of which no doubt was a puzzle to him. He resolved these difficulties by converting it into a geometrical pattern, which, however, he was careful to restrict to the area occupied by the relatively small pinna that is distinctive of the Indian species of elephant. (In the representation of elephants on a beautiful Chinese vase of the Ming period, now in the Victoria and Albert Museum, the posterior border of the pinna is lobulated, and suggests a transition to the geometrical pattern of the Copan design.)

The designer also lost his bearings when he came to deal with the turbaned rider of the elephant. No doubt in the original model the rider's leg was obscured by the pinna; but in the Copan sculpture he has lost his trunk also.

All these features go to prove quite conclusively

that the sculpture represents an elephant's head, and that it was not modelled from the real creature. In other words, the craftsman was copying an earlier model (presumably made by some immigrant from Asia) without understanding the "points" of the elephant.

In the introduction to his "Mexican Archæology" (1914) Mr. T. A. Joyce refers to Dr. A. P. Maudslay and Dr. Seler as leading modern investigators who "have done so much to place the study of American antiquities upon a thoroughly scientific footing." It is interesting to inquire what the voice of modern science has to say with reference to these Copan elephants.

In part ii. (text, p. 43) of his great monograph, to which I have already referred, Dr. Maudslay says, in his description of the figure which I have reproduced here:—"The elephant-like appearance of these heads has been the subject of much discussion, but I fail to see any reason why the form may not have been taken from the tapir, an animal still commonly found in the neighbourhood." But if this is so, it is surely a remarkable coincidence that, when the sculptor set about transforming the tapir into so untapir-like a form, he should have arrived at the precise profile of the Indian elephant. Moreover, if the tapir was so familiar to him, why did he mistake its eye for its nostril and its meatus for its eye? Why also did he add the embellishments exactly corresponding in distribution to the elephant's pinna, tusk, and under surface of the trunk, which become meaningless if the creature is a tapir? The position of the turbaned man on the head, as well as the instrument in his hand, also become unintelligible if the head is that of a tapir.

Dr. Eduard Seler holds very different views, which do more credit to his powers of imagination than to his plausibility. For he regards the objects under discussion as heads of tortoises! It is scarcely necessary to follow the remarkable line of argument which led him to this astounding conclusion (*Archiv f. Ethnologie*, 1910, pp. 50–53).

Dr. Seler's view is all the more remarkable in view of the fact that in the same journal two years previously (*Archiv f. Ethnologie*, 1908, p. 716) Dr. W. Stempell (after reviewing the literature concerning these elephant heads from the time of van Humboldt onwards) vigorously protested against the idea that they were intended to be anything else than elephants. He claimed that no one with any zoological knowledge could have any doubt on the matter. But with an amazing disregard for considerations of chronology he suggested that they represent the early Pleistocene *Elephas columbi*!

If these sculptures, definite as their features are, were the only representations of the elephant in pre-Columbian America, one might perhaps be justified in adopting an attitude of reserve as to their significance. But they do not stand alone. Another most remarkable and unmistakable example appears as a head-dress in a bas-relief at Palenque (see Bancroft's "Native Races of the Pacific States of North America," vol iv., p. 305). Another is a highly conventionalised representation of an elephant's trunk, which appears as a projecting ornament on the Casa del Gobenador at Uxmal (Bancroft, *op. cit.*, p. 163).

Equally remarkable instances of the use of the elephant as a design—in these cases the whole creature—will be found in the so-called "Elephant Mound" of Wisconsin, and the "Elephant Pipes" of Iowa (see Henshaw, Second Ann. Report of the Bureau of Ethnology, for 1880–1, pp. 152 and 155 respectively, and McGuire, "Pipes and Smoking Customs of the American Aborigines," 1898, p. 523).

The use of the elephant design in these different ways becomes more intelligible when it is recalled that in India and eastern Asia the elephant was frequently represented on temples and dagobas, and special sanctity became attached to it in religious architecture. Some of the earliest sculptured representations of the elephant in India, going back to the Asokan period (third century B.C.), are found to have the tusk and the ventral surface of the trunk exposed in precisely the same way as the Copan elephants (see, for example, A. K. Coomaraswamy's "Visvakarmā," 1914, plate 91).

Thirty-six years ago Sir Edward Tylor proved that the pre-Columbian Mexicans had acquired the Hindu game called *pachisi* (Journ. Anthr. Inst., 1879, p. 128). Fifteen years later the same distinguished anthropologist directed attention (British Association Report, 1894, p. 774) to the fact that the Mexican scribes had represented in their Aztec picture-writing (Vatican Codex) a series of scenes taken from Japanese Buddhist temple scrolls. If this is admitted—and the facts are much too definite and precise to be denied—the last reason disappears for refusing to admit the identification of the Copan heads as elephants. For if it has been possible for complicated games and a series of strange beliefs (and elaborate pictorial illustrations of them) to make their way to the other side of the Pacific, the much simpler design of an elephant's head could also have been transferred from India or the Far East to America.

G. ELLIOT SMITH.

The University of Manchester, November 10.

Commercial Firms and Scientific Inventors.

THE daily Press is now beginning to take up the question of encouraging British inventors with the object of capturing German trade after the war.

May I direct attention to what I regard as a serious deterrent to any scientific man who is capable of producing inventions of practical value.

As many readers of NATURE are aware, after more than ten years' practical experience in the use of piano-players, I patented an expression device, the use of which I found to be absolutely necessary in order to get the satisfaction I required from my music. It has now been put on the market by the Motomusic Company, of 42 Eyre Place, Edinburgh, but both before and after this I found that it was quite impossible to bring it properly before the notice of some of the leading London firms. Had the makers merely raised difficulties of a purely practical kind no objection could have been taken to their attitude, but instead of this their representatives persisted in attempting to talk me down with arguments to the effect that it was theoretically impossible that my invention could produce the results that I claimed for it. It soon became evident that these so-called practical men based their objections on an entire misunderstanding of the principles of elementary dynamics and physics, and it was quite impossible to make them understand things which I could easily have explained to one of my first year students.

It should surely be evident to the most practical business man that a fellow of the Royal Society, who has gained additional distinctions in mathematics and physics, would not waste time and money in patenting an invention unless he were perfectly satisfied as to its unique efficiency on theoretical grounds, particularly if the principles underlying it belonged to the branch of science in which he specialised. I have tried most makes of piano-player, but at the present time there is not one which I would care to play on unless my patented invention were incorporated in it.

It therefore became necessary for me to patent this device independently of commercial considerations, and the Motomusic Company soon realised its advantages. But until the attitude of commercial firms towards scientific inventors has considerably changed I shall continue to avoid undertaking any investigation the results of which may be directly capable of commercial application. If this be impossible, I shall continue to follow my previous practice of rendering such inventions unpatentable by the method of publication; and I advise others to do the same. Of course, there is nothing to prevent Germans from exploiting inventions that have been published without previous protection (*e.g.* the "Thermos" flask). G. H. BRYAN.

The Aurora Borealis of November 5.

WITH reference to the description in NATURE of November 18 (p. 314) of the appearance of the aurora borealis in Yorkshire about 7 p.m. on the evening of November 5, I may mention that I saw it at the same time from the neighbourhood of Broadley Common, in the west of Essex, latitude 51° 45′ N.

It formed a low, colourless luminous arch on the northern horizon, probably about 6° high and 30° in length. There were no streamers, and no movement was visible. J.

November 19.

As a supplement to the observations of Mr. Scriven Bolton on the aurora borealis of November 5, and his beautiful illustrative drawing (NATURE, November 18), may I be allowed to record the following observations. Mr. Scriven Bolton ceased observing at 7.40 p.m.; I began at 8 p.m., although the aurora had been noticed about 7 p.m. The aurora appeared in the form of a bright whitish-green glow, of the form depicted by Mr. Scriven Bolton, extending on the horizon from N. by E., to W. by N., with streamers occasionally rising from it. At 8.25 p.m. the general glow was affected with pulsations, and at 8.40 p.m. five comet-like streamers appeared in the N.W., and a brighter patch of luminosity N. by W. A single streamer appeared in the N. at 8.45 p.m., and at 8.50 p.m. a dark arch formed, separating an upper bright arch from the brightly glowing region beneath. This must not be confounded with the dark segment, so often seen in auroræ surmounted by a bright arch. This particular phenomenon I do not remember to have observed before in auroral displays.

At 8.55 p.m. the luminous arch rose rapidly, reaching to the Pointers of the Great Bear, and became very bright. It then, 8.58 to 9.0 p.m., divided in the middle, and broke up into luminous clouds, which appeared to drift, until a very bright patch was formed due W. The bright clouds had disappeared by 9.2. p.m., but five minutes later the summit of the arch formed again, though it was much fainter than before. It then increased in brilliancy, and disappeared at 9.9 p.m. At 9.12 p.m. a very bright streamer arose in the N.W. At 9.15 p.m. the sky became overcast with dark, filmy stratus clouds. The luminous patch in the W. was also observed earlier in the evening, at about 7.0 p.m. The stars seen through these bright clouds were certainly dimmed in lustre. Looking at the bright glow with a direct-vision prism, I could only see a mere ghost of light in the green.

The aurora was observed during a disturbance of greater intensity on the magnetic needles. A marked easterly movement in declination was synchronous with the formation of the dark arch, and with the rising and marked increase of luminosity of the bright arch. A. L. CORTIE.

Stonyhurst College Observatory, November 20.

A Remarkable Solar Halo.

A SOMEWHAT remarkable halo was visible at Bristol for more than an hour during the morning of Thursday, November 11, between nine and half-past ten. At nine the sky was bright and almost cloudless; a couple of hours or so later it was completely overcast and much rain fell. The halo was white with a slight red coloration on the inside edge, and the whole circle was visible. The most striking feature at 9.30 was the clearness of the sky outside the ring, and its darkness inside. It looked just like a circular cloud of smoke bounded by a bright ring. When measured by my colleague, Mr. Broadbent, the diameter of the halo was found to be 44° 10′.

DAVID ROBERTSON.

Merchant Venturers' Technical College, Bristol, November 17.

Rule for Determining Direction of Precessional Movement.

PROF. A. M. WORTHINGTON has kindly pointed out to me that my interpretation of Prof. Watanabe's rule (NATURE, October 21, 1915) gives the wrong direction of azimuthal turning for the gyroscope. In my statement, *for* upper part of the wheel *read* lower part of the wheel. A. GRAY.

The University, Glasgow.

SCIENTIFIC EXPOSITION AT ITS BEST.[1]

(1) ALL who have enjoyed Sir Ray Lankester's popular essays published in the *Daily Telegraph* under the title "Science from an Easy Chair," will be glad to have a third instalment of them in permanent form; those to whom they are new are to be envied. The mood of the essays expresses the conviction that while science is for foresight and the practical mastery of things, it is also for our delight, "in this world of unending marvels and beauty." Far from echoing the old moan that increase of knowledge is increase of sorrow, the author declares that science "satisfies man's soul." To accept this generous appreciation it may be necessary, however, to include with "science" the attendant feelings and imaginings which are usually kept at a stern arm's length off.

What are the characteristics of these masterly essays, when we get beyond their obvious qualities of learning and lucidity, experience and insight? The first is that Sir Ray Lankester, like Huxley before him, is able to show us the interest and significance of common things. Thus there are illuminating chapters on the sand and pebbles and shells of the sea-shore, on a piece of amber, on sea-anemones and jelly-fish, shrimps and barnacles, on daddy-long-legs, on Christmas trees, and more besides. It is the function of art and poetry to idealise what we see and do every day; but science also has its share (for there are really no hard and fast compartmental *rôles* in life) in showing us the significance of the commonplace, and fine examples of lucid exposition of difficult,

[1] (1) "Diversions of a Naturalist." By Sir Ray Lankester. Pp. xv.+422 (London: Methuen and Co., Ltd.) Price 6s.

(2) "The Birth-Time of the World and Other Scientific Essays." By Prof. J. Joly. Pp. xv.+307. (London: T. Fisher Unwin, 1915.) Price 10s. 6d. net.

(3) "Birds and Man." By W. H. Hudson. Pp. 306. (London: Duckworth and Co., 1915.) Price 6s. net.

though near-at-hand, subjects will be found in the essays on the blood and the lymph.

Another feature is the author's felicitous suggestion of movement. Nothing, not even a fossil, is finished and done with; there is question on the back of question; science is a developing system. So the essays give us problems to stretch our brains over, such as the production of orange-coloured flames under water by rubbing quartz-pebbles together; the moth's flight into the candle; the puzzles of animal courtship; the science of dancing; the missing link, *Eoanthropus dawsoni*, better known as the Piltdown skull; the difference between instinctive behaviour (regarded as due to automatically-working, inherited, "mechanisms of the mind"), intelligent behaviour (regarded as based on learning by individual experience), and the conscious behaviour of man and some higher animals where educability is illumined by self-recognition.

In the essays on palmistry, toads in stones, "dousing," maternal impressions, telegony, and the like, the reader will have the pleasure (or otherwise) of seeing how a "tough-minded" inquirer exposes the weak points of faked evidence. "The whole spirit of science, as contrasted with that of superstition and ignorance, is summed up in the Royal Society's motto, "Nullius in verba" (on no man's assertion!), and King Charles's command, "Don't chatter; make trial!"

Another of the characteristics of Sir Ray Lankester's popular essays is the emphasis laid on making the most of things. Science is for life, not life for science. The question is never far off: Cannot man make more of his kingdom? Thus we find essays on the importance of Nature-reserves, both at home and abroad, where wildness is allowed to flourish and shy creatures feel at home; on the promotion of scientific discovery by money—the plan being to watch for the quite unmistakable discoverer and commandeer him in the service of the State at a generous salary; on the supply of pure milk, and the most effective kind of diet—"not much, but many."

A few more personal chapters complete the charm of the volume, as when the author tells of dredging in Norwegian fjords, of finding a newly-born grey seal on the shore of Pentargon Cove in Cornwall, and of the flowers in the meadowland above Argentière. In regard to the bright colour of Alpine samples of flowers which are paler elsewhere, the author holds that there are genuine high-coloured races (rendered possible by the nutritive vigour of much-sunned plants) which have survived in the short summer of the high Alps since they attract the visits of the pollinating insects more surely than do the paler individuals. It is fitting indeed that our notice of this delightful book should happen to end at a high level!

(2) Prof. Joly's book consists of twelve essays, old and new, all of fascinating interest. They are full of original ideas, they show great expository skill, and they make considerable demands on the reader's intelligence, encouraging him, however, with a fine suggestion of the bracing air of Alpine heights. (The book is illustrated with beautiful photographs of the Alps, to which the author owes some of his inspiration.) The first essay, on "The Birth-time of the World," infers from denudative effects and radioactive products the time that has elapsed (perhaps a hundred million years) since the ocean condensed upon the earth's surface. The second essay argues from the quantity of sodium in the sea to the activity of denudation throughout geological time, and it seems that rather more than a depth of two kilometres of parent rock must have been removed from off the entire land surface of the globe. The essay on "Mountain Genesis" seeks to show that the heat of radioactivity has been a factor in determining the surface features of the earth; and this is followed up by a discussion of Alpine structure. A very ingenious attempt is made to interpret the much-discussed details on the surface of Mars as physical surface features. "Mars presents his

FIG. 1.—The Great Aletsch Glacier. From "The Birth-Time of World.

history written upon his face in the scars of former encounters—like the shield of Sir Launcelot," and as to the theory of organismal intervention, the author very wisely remarks: "In seeking other minds than ours we seek for what is almost infinitely complex and co-ordinated in a material universe relatively simple and heterogeneous."

Another essay deals with "pleochroic haloes," microscopic darkened spheres in certain of the rock minerals, which turn out to be "a quite extraordinary record of radioactive energy," and afford very striking evidence of the unchanged stability of the common elements since the beginning of geological time. In another discourse the author takes a very hopeful view of the application of radioactivity in medicine, and has some important suggestions to make. A somewhat

technical essay deals with the latent image in photography, while skating is the subject of a very successful popular lecture at a high level. A selectionist interpretation is given of the brightly-coloured Alpine varieties of certain flowers, for pollinating insects are scarce and readily benumbed, and survival rewards variants in the direction of brighter blossoms. To this is appended a theory of the way in which "a unified course of economical expenditure" is impressed upon the organism, and gives to "the developmental progress of the individual its prophetic character." But the theory is stated very elliptically, and does not seem to us to be very clear.

In his concluding essay, which rather takes our breath away, Prof. Joly argues that the present gravitational properties of matter cannot be supposed to have acted for all past duration, and proceeds to speculate concerning the pre-material

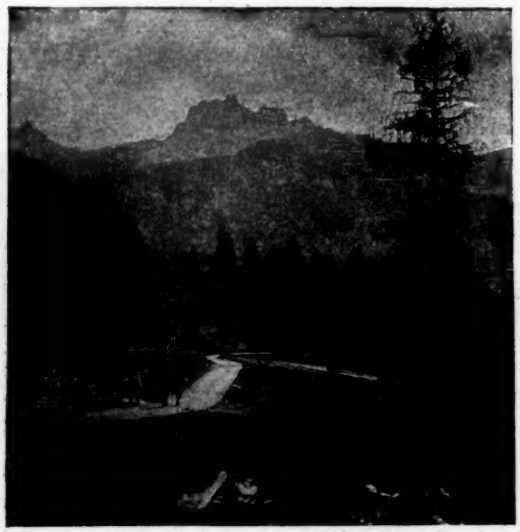

FIG. 2.—The Ampezzo Thal. Dolomite Alps. From "The Birth-Time of the World."

state of the universe, when kinetic entities, not yet materialised, exhibited a dreary succession of unprogressive, fruitless motions.

It gave us a pleasant thrill to renew acquaintance after a quarter of a century with a remarkable essay entitled, "The Abundance of Life"—certainly one of the most instructive contributions that have been made to the contrast between animate and inanimate material systems. The contrast is stated in physical terms: "The transfer of energy into any inanimate material system is attended by effects retardative to the transfer and conducive to dissipation. The transfer of energy into any animate material system is attended by effects conducive to the transfer, and retardative of dissipation. The organism is a configuration of matter which absorbs energy acceleratively, without limit, when unconstrained." The attitude of the organism towards energy external to it "results in its evasion of the retardative and dissipatory effects which prevail in lifeless dynamic systems of all kinds." But what is it in the organism that enables it to take the attitude thus so admirably defined?

(3) A re-publication of Mr. Hudson's "Birds and Man" is very welcome, for no such wise and beautiful book should be allowed to get out of print. He tells us of "birds at their best," that is, in their native haunts all-unsuspecting, and of the enrichment which their beauty brings to the open mind; of the reality of sympathy between living creatures, for instance, between wagtail and cow, robin and man; of the pleasingness of all natural sounds heard in their proper surroundings; of the secondary æsthetic element which the voices of some birds have, inasmuch as they approach the expressive tones of the human voice; and of the secret of the charm of flowers, which seems to us to exaggerate, almost *ad absurdum*, the associative factor in æsthetic emotion. His chapters on ravens, owls, and geese are charming and illuminating appreciations; his protests against the "cursed collector" and his patrons, and against stuffed birds as household decorations are still too dismally relevant—though we think that there has been a wholesome change in public opinion to which Mr. Hudson's insight and infectious enthusiasm have effectively contributed. We confess, too, that we have more hope for the conservation of the beautiful along this line than by the severe legislation which the author suggests. At the end the book brings us very picturesquely to Selborne and to an imaginary conversation with Gilbert White, which is high art and sound sense too. The frontispiece of this delightful book is a very fine coloured picture of the furze wren or Dartford warbler.

JOHN DALTON AS A SCIENCE LECTURER.[1]

AS is well known, John Dalton began his academic career at the age of twelve, by a public announcement, affixed to the door of his father's cottage, that he was prepared to impart the elements of a liberal education to the youth of Eaglesfield, of both sexes, on reasonable terms. In actual attainment he was probably not greatly in advance of his scholars—some of whom were lads of sixteen or seventeen, who offered to fight their mentor when disciplinary duty was to be done. In moral power and mental vigour he was more than a match, we may be sure, for even the most pugnacious of his pupils. These qualities doubtless secured for him the ascendency proper to his position as the principal.

During this short apprenticeship to the profession of a pedagogue, Dalton sowed the seeds of his future greatness. A couple of years' experience of self-taught teaching, when wholly dependent upon his own powers of self-reliance, acquisitiveness, and industry, must, at such a period

1 "John Dalton's Lectures and Lecture Illustrations." Parts i. and ii. by Prof. W. W. Haldane Gee. Part iii., by Dr. Hubert F. Coward and Dr. Arthur Harden. (Manchester: Literary and Philosophical Society, 1915.) Price 1s. 6d.

of his mental development, have greatly tended to form and strengthen his intellectual character. The fact is, Dalton was a born teacher, and, luckily for the world, he realised his true vocation. He then joined his elder brother Jonathan in carrying on Mr. Bewley's school at Kendal, and for twelve years he instructed the youth of both sexes in English, Latin, Greek, and French; writing, arithmetic, merchants' accounts, and the mathematics. It is interesting to trace, from the school syllabus issued by the brothers, how John was gradually drawn to the study of science, first to the oldest of all the sciences, astronomy, and then to the various branches of physics, or natural philosophy, as it was then termed. The late Prof. Huxley used to say to his colleagues, "If you want to get up a subject, offer to lecture upon it," and Dalton would seem, in practice, to have acted upon this principle. The school syllabus was gradually enlarged until, as Sir Henry Roscoe says, it "forcibly reminds us of that of a technical school of the present day."

When twenty-seven years of age, John Dalton accepted the position of tutor in mathematics and natural philosophy at the Manchester Academy, and for upwards of fifty years Manchester continued to be his home until his death at the age of seventy-eight.

For some years prior to his removal to Manchester Dalton had offered to give public lectures, and the Manchester Literary and Philosophical Society possesses copies of the prospectus he issued for courses on natural philosophy to be held at Kendal—"Admittance 6*d*. each lecture, or 5*s*. the whole." After his removal to Manchester he again arranged for a course at Kendal "as far as the apparatus there would admit"—"about six lectures on chemistry and six on the other branches would be my plan." Tickets for the course to admit a gentleman and lady, or two ladies, 10*s*. 6*d*.; single lectures, 1*s*. 6*d*.

Dalton was now fully embarked on the career of a public lecturer on science, and until he was close upon seventy years of age there were few years in which he was not called upon to give courses. At the instigation of Davy he was early invited to London—Albemarle Street sharing with Athens a passion for the newest thing—to receive from the youthful *protégé* of Rumford, himself some twelve years Dalton's junior, instruction in declamation, and in the art and mystery of holding the attention of a Royal Institution audience.

In the publication before us Dalton's later career as a science lecturer is succinctly set forth. He repeated his London lectures in Manchester. "In a populous town like this, where the arts and manufactures are so intimately connected with various branches of science, it may be presumed that public encouragement will not be wanting to a person qualified to exhibit and illustrate the truths of experimental philosophy upon a liberal and extensive scale." Nor was it. John wrote to Jonathan that "a more respectable audience has seldom been had on a similar occasion." In 1807 he was invited to Edinburgh, and subsequently to Glasgow, where, as he says, "he was honoured with the attention of gentlemen, universally acknowledged to be of the first respectability for their scientific attainments, most of whom were pleased to express their desire to see the publication of the doctrine." The "doctrine" thus indicated took the shape of that epoch-making work, "A New System of Chemical Philosophy," part i. of which appeared in the following year.

Although the greater number of Dalton's public lectures were given in Manchester, at the rooms of the Literary and Philosophical Society, of which he became the honoured president, or at Thomas Turner's Medical School in Pine Street, or at the Royal Manchester Institution, or at the Mechanics' Institution, where he gave his last lecture, in 1835, on the Atomic Theory, he was readily induced, until age and physical infirmity began to tell upon him, to visit the neighbouring towns, and Leeds and Birmingham were in turn favoured with his presence. All that can be ascertained respecting these various courses, and especially of the diagrams and illustrations used by Dalton in connection with them, most of which seem to have been prepared by himself, is set forth in the interesting account before us. The diagrams, 150 in number, are the property of the Manchester Literary and Philosophical Society, and Prof. Haldane Gee, and Drs. Coward and Harden have done a signal service to the history of one of the most remarkable epochs in science in giving a description of the more important of them, and of the circumstances under which they were first employed by their illustrious author.

T. E. THORPE.

PROF. RAPHAEL MELDOLA, F.R.S.

SCIENCE and the world are alike the poorer by the sudden death of Prof. Meldola on Tuesday, November 16. Naturalist, chemist, physicist, and man of affairs, it is no easy matter to estimate, thus near to that sad event, the value of his work and influence. But we may recall the facts that at the time of his death he had been for thirty years professor of chemistry at the Technical College, Finsbury, a part of the City and Guilds of London Institute, that he was also a vice-president of the Royal Society, a member of the Advisory Council appointed by the Privy Council to promote scientific research in relation to trade and industry, and chairman of the Advisory Council of the Board of British Dyes (Ltd.), a commercial organisation fostered by Government to assist in the manufacture of dyestuffs in the United Kingdom.

Raphael Meldola was the only son of the late Samuel Meldola, and was born in Islington July 19, 1849. They came of an ancient Sephardic family, the Sephardis being Spanish and Portuguese Jews, the more aristocratic section of the race. The genealogy of the Meldolas can be traced through sixteen generations without a break, back to Isaiah Meldola (*b*. 1282, *d*. 1340), of Toledo. Under Spanish names the family flourished long in Toledo, and produced many men of

note and learning. The name Meldola seems to have been assumed from the place of that name not far from Ravenna, when some of the family established themselves in Italy. The earlier members of the family for many generations were the Chief Rabbis of their communities.

Raphael Meldola was educated in private schools and the Royal College of Chemistry. At a very early age he was for a time in the private research laboratory carried on by Dr. John Stenhouse, F.R.S., and after two years in a colour works at Brentford, he joined, in 1872, the teaching staff of the Royal College of Science under Prof. Frankland. His training, therefore, had been chemical, but it is interesting to notice how his inclinations often led him in other directions, for the first seven papers under his name in the Royal Society catalogue all relate to subjects of natural history, especially in connection with mimicry and protective colouring in insects. This interest he always maintained, and he was twice president of the Essex Field Club (1880–83 and 1901–2), and later president of the Entomological Society in 1895–97.

While still at South Kensington he assisted Sir Norman Lockyer in spectroscopic work in the Solar Physics Laboratory, and in 1875 was placed in charge of the British Eclipse Expedition to the Nicobar Islands in the Bay of Bengal.

By the outer world, however, Meldola has always been thought of chiefly as a chemist specially familiar with the chemistry of colouring matters. His first paper on a chemical subject was, in fact, a "Preliminary Notice of a New Yellow Colouring Matter," published in 1878. This was followed immediately by studies in the naphthalene series, and three years later he announced a "New Class of Colouring Matters from the Phenols" in the Transactions of the Chemical Society (1881). In the meantime he had joined the firm of Messrs. Brooke, Simpson, and Spiller, in whose works at Hackney Wick he remained eight years, and where he made important practical discoveries, including the dye known in Germany as Meldola's blue. While at Hackney he was associated with the late Mr. R. J. Friswell and with Prof. A. G. Green, now of Leeds University, with whom he retained a close friendship, and from whose competent pen we may expect to receive before long a full account of Meldola's technical as well as scientific colour researches.

In 1885 Meldola was appointed to the chair of chemistry in the Technical College, Finsbury, and there he taught many generations of students, in the list of whom are to be found the names of Profs. Forster, Morgan, and W. J. Pope, all fellows of the Royal Society, besides many others well known in the teaching or industrial worlds.

As to his work at Finsbury, Prof. Silvanus Thompson, Principal of the college, writes as follows:—"Meldola was invaluable to his colleagues as a wise adviser, a steady, constant, and loyal colleague. He used, however, to complain privately of the considerable proportion of his time which was taken up by correspondence with his students, and with writing testimonials for them, but he never stinted the time or pains he took to respond to appeals for this kind of help. The quantity of work he got through during the last twelve months, and more, is to me simply amazing, and this in spite of the severe illness (involving a surgical operation) of last spring. And he wrote long letters from Bournemouth and elsewhere on details of laboratory organisation and questions of staff arrangements, etc., with minute care. We had many long country walks together, and thus, apart from my daily intercourse with him for thirty years, I had the fullest opportunities of knowing what a richly-stored mind he had, and what a noble simplicity and sincerity of nature was his."

To this testimony, which will be most heartily confirmed by his many other friends, it should be added that while Meldola was by nature a most amiable man, in demeanour modest and undemonstrative, he was a very competent chairman, clear in his judgment, firm when necessary, at the same time full of tact.

Meldola served many societies. In addition to those already mentioned he was president of the Chemical Society (1905–7), of the Society of Dyers and Colorists (1907–8), of the Society of Chemical Industry (1908–9), and of the Institute of Chemistry (1912–15). These offices gave opportunities for the expression of his views about such important public questions as the relation of science to industry and the necessity for research.

"We must take," he says in one place, "a broad, an imperial view of original research if we desire, as we all do, to influence the public mind. Every discovery emanating from your laboratories not only helps to extend the boundaries of our science, but it helps also to uphold the general principle that original research is in itself, and by itself, the most powerful weapon that has been or ever can be wielded by mankind in struggling with the great problems which nature offers on all sides for solution."

Nor must be forgotten the numerous occasions on which Meldola pointed out the cause of the departure of the coal-tar colour industry from this country, where it originated, and warned the British public of what would probably ensue if the indifference prevalent among manufacturers continued to exist in this country. These warnings remained practically unheeded till the outbreak of war forced into prominence the unpleasant fact that this country was destitute of dyes, drugs, and all chemicals of the finer sort. When the history of these times comes to be written Meldola will not be forgotten.

Space does not allow us to do more than recall the active interest he took in biological problems, as indicated by his translation of Weismann's "Theory of Descent" (1882–83) and by his own work on mimicry in insects already mentioned, but it is to be hoped that a full estimate of the value of his researches in this direction will be provided by some of his biological friends.

Among the honours conferred on Prof. Meldola were the honorary degrees of D.Sc. Oxon.,

LL.D. St. Andrews, and in 1913 the Davy Medal of the Royal Society. He was also elected a member of the Athenæum Club under Rule ii. He was president of the Maccabæans in 1911. In 1886 he married a daughter of the late Dr. Maurice Davis, J.P., who survives him.

W. A. T.

Raphael Meldola occupied a unique position. In an age of ever-increasing specialisation he kept alive and fresh every one of the diverse interests that had appealed throughout his life to his many-sided intellect: by sure scientific insight he spoke with authority on them all. What scientific man of our time could have brought out in a single year three memoirs dealing with subjects so far removed from one another as the following?—

"Contributions to the Chemical History of the Aromatic Derivatives of Methane" (Trans. Chem. Soc., May, 1882); "Mimicry between Butterflies of Protected Genera" (*Ann. Mag. Nat. Hist.*, December); "Preliminary Report of the Committee appointed to investigate the Ancient Earthwork in Epping Forest known as the Loughton Camp" (Report Brit. Assoc., 1882, p. 274).

Apart from his researches in organic chemistry, and his work on natural history, Meldola conducted and wrote the report on the Eclipse Expedition to the Nicobar Islands (1875); founded the Epping Forest and County of Essex Naturalists' Field Club, laying down in the inaugural address (1880) the policy and lines of work which have made this society one of the best in existence, gave in the coming-of-age address a *résumé* of all that had been accomplished; wrote, with his friend, William White, the first volume of special memoirs of the club—an account of the East Anglian earthquake of April 22, 1884; took a leading part in founding the Corresponding Societies of the British Association (1883); defended the "scientific use of the imagination" in the study of insects in his first presidential address to the Entomological Society of London (1896); considered the part played by physiological correlation in the utility of specific characters in his second address; delivered the Herbert Spencer lecture at Oxford on "Evolution, Darwinian and Spencerian" (1910).

Meldola was naturally brought, by the immense breadth of his interest, into intimate association with the leaders in all branches of science. Hence, with his well-known unselfishness and warm-hearted appreciation of good work of every sort, he was often applied to for help, and took a prominent part in movements for the recognition of important researches, or for preserving the memory of great men. This and the public work—especially in connection with scientific and technical education and industry in its relations with science—he was constantly called on to perform, cut deeply into his limited time and his strength, which was never great.

Natural history was his first love. He began to write papers, especially dealing with British insects, in 1868, six years before his first chemical research was published. The necessities of space forbid anything more than a brief account of his principal work—the development of the theories of insect mimicry and allied subjects. In this he was encouraged by Charles Darwin, who sent him letters received from Fritz Müller in Brazil, and suggested the translation of Weismann's "Studies in the Theory of Descent" (1881–2). Thus it came about that Fritz Müller's work and the theory of Müllerian mimicry became known in this country almost as soon as in Germany, and penetrated the world through more important and far-reaching channels. These and Meldola's own researches, published in several memoirs, together with his translation of Weismann, greatly enriched by his editorial notes, erected, upon the foundation supplied by Bates and Wallace, the peculiarly British study of the bionomic value of colour, marking, and attitude in nature.

Meldola always spoke with the greatest enthusiasm of his association with Darwin and his visits to Downe. He had the distinction of being proposed by Charles Darwin as a candidate for the fellowship of the Royal Society. Among Meldola's warmest friends were Wallace, Bates, and Trimen, his seniors in the important department of evolution that he made his own. Those who came later and attempted to confirm and extend his work can never forget the encouragement they owe to his constant sympathy and help.

The present writer feels the inadequacy of this brief notice, and regrets that in the allotted space it was impossible to prevent it from bearing the appearance of a list.

In the future period of reconstruction Meldola's many-sided activities and devotion to science would have been a precious asset to the nation; but in this sad hour the loss that presses most heavily is that of a dear friend and brother in science.

E. B. P.

DR. H. CHARLTON BASTIAN, F.R.S.

BY the death of Dr. Charlton Bastian on November 17, the last of a distinguished band of men of science, which numbered among its members Pasteur, Darwin, Huxley, and Tyndall, has passed away.

Born at Truro in 1837, Dr. Bastian was educated at University College and Hospital, London, and graduated M.A. in 1861 and M.D. in 1866 in the University of London. His first appointments were those of lecturer on pathology and assistant physician at St. Mary's Hospital; these posts he held until 1867, when he was elected professor of pathological anatomy in University College Hospital. He afterwards became physician to this hospital, and in 1887 professor of the principles and practice of medicine there.

Dr. Bastian devoted minute and prolonged study to the nature and functions of the brain and nervous system. He was a recognised authority on nervous affections, and was for some years physician to the National Hospital for Paralysis and Epilepsy, as well as being a Crown referee in cases of supposed insanity. His best known

works on the nervous system are "The Brain as an Organ of Mind," "Paralyses: Cerebral, Bulbar, and Spinal," and "Aphasia and other Speech Defects." Herbert Spencer was a life-long friend, and, as one of his trustees, Dr. Bastian was joint-editor of that writer's posthumous "Autobiography." He was also a naturalist of catholic tastes, and contributed a monograph on the Anguillulidæ, a family of free nematode worms, to the Linnean Society and compiled a "Flora of Falmouth."

But it is particularly in connection with the "origins" of life that Bastian's name will be chiefly remembered. Contrary to generally accepted views, he denied that life always originates from pre-existing life, and maintained that, just as presumably in past ages life developed from non-living matter, so at the present time lowly living organisms are, under certain conditions, being generated from non-living elements. He was, in fact, an upholder of the doctrine of spontaneous generation, or, as he preferred to term it, of "archebiosis." By the use of solutions containing colloidal silica and iron, enclosed in sealed glass tubes and sterilised by heat, and maintained under particular conditions of light and temperature, he claimed that after a time micro-organisms, such as bacteria and torulæ and even moulds, developed. His results have been detailed in several papers which have appeared in the pages of NATURE during the last few years, and in "The Beginnings of Life" and "Nature and Origin of Living Matter." Few have cared to undertake the laborious investigations necessary to follow this work, which cannot be said to have been confirmed, though the MM. Mary, of Paris, and a correspondent writing only last week in the *English Mechanic*, state that they have observed the development of lowly organisms in culture tubes prepared according to his directions.

Dr. Bastian also supported the doctrine of "heterogenesis," the sudden appearance of one kind of organism as the offspring of another, *e.g.*, ciliates and flagellates descending from amœbæ. This work was published in book form under the title of "Studies in Heterogenesis." Dr. Bastian maintained his views against all opposition with a tenacity and ingenuity which won the respect of his bitterest opponents. A man of great personal charm and originality he literally died in harness, for up to three or four months ago he was continuing his investigations and planning new experiments with a vigour which showed little decline in spite of his four-score years, and to the last his interest in science he had served so well remained undimmed. R. T. H.

NOTES.

HIS MAJESTY THE KING has been pleased to approve of the following awards this year by the president and council of the Royal Society:—A Royal medal to Prof. Sir Joseph Larmor, F.R.S., for his numerous and important contributions to mathematical and physical science; a Royal medal to Dr. W. H. R. Rivers, F.R.S., for his important contributions to ethnography and ethnology. The following awards have also been made by the president and council:—The Copley medal to Prof. Ivan Petrovitch Pavlov, for his investigations in the physiology of digestion and of the higher centres of the nervous system; the Davy medal to Prof. Paul Sabatier, for his researches on contact action and the application of finely-divided metals as catalytic agents; the Hughes medal to Prof. Paul Langevin, for his important contributions to, and pre-eminent position in, electrical science.

THE Admiralty announces that Staff-Surgeon G. M. Levick has been specially promoted to the rank of Fleet Surgeon for his services with the British Antarctic Expedition in 1910.

THE council of the Royal Meteorological Society has awarded the Symons Memorial gold medal, which is presented biennially for distinguished work done in connection with meteorological science, to Dr. C. A. Angot, director, Central Météorologique de France, Paris. The medal will be presented at the annual general meeting of the society on January 19, 1916.

IN the death of Lieutenant Frank Stevenson Long, 11th Essex Regiment, British science loses a young man of great promise. Educated at Parmiter's School, he proceeded to East London College as a Drapers' Company scholar in 1906, and graduated with first-class honours in chemistry in 1909. He acted as demonstrator in the chemical department for a year, publishing his first paper on the velocity of addition of alkyl bromides to cyclic tertiary bases in the Transactions of the Chemical Society in 1911. In the same year he took honours in physics, and went to Cambridge, first as a member of the Day Training College, and successively as secretary to the censor and librarian at Fitzwilliam Hall. At the outbreak of war he had already taken the mathematical tripos in the first class, and was intending to sit for physics in the following June. With such careful preparation for his future work and with so wide an outlook, Long was regarded as a man for whom a brilliant career could safely be predicted. He obtained his commission in September of last year, and was killed in action on September 26, 1915.

A BRONZE statue of Captain R. F. Scott, R.N., subscribed for by officers of the Navy, has been erected in Waterloo Place. The statue, which shows the explorer in polar dress, is the work of Lady Scott. Mr. A. J. Balfour, First Lord of the Admiralty, in unveiling the statue on November 5, said that it was not a bad thing even in the midst of a great war to remember how great have been the performances of the British Fleet in times of peace. The statue was to commemorate the hero of one of those peaceful victories which resemble the victories of war, in that it involved danger, struggle, and an heroic death. We are apt to forget how much the Navy has done in the unwarlike and yet most dangerous work of exploration, travel, and of wresting from nature secrets most jealously held. Captain Scott was worthy to be ranked with those two great explorers whose

statues stood not far off—Sir John Franklin and Captain James Cook. He had one great advantage, Mr. Balfour pointed out, over every other man whose memory is commemorated by statues. In most cases the artist has to do his best from such pictures as remain, or from the memory of friends and relatives, but Captain Scott had a happier and far rarer destiny, for his statue had been made by Lady Scott.

THE New School of Tropical Medicine and Research Laboratories in Calcutta are, according to the *Pioneer Mail* of September 8, now ready for occupation. They will be associated with the Calcutta Medical College, so that a constant supply of tropical material will be available for study, and this will be one of the main objects to which research will be directed, viz., the elucidation of disease. Another subject to which study will be devoted will be the pharmacology of Indian drugs; if we may include quinine in this category this drug must take premier place in such researches. The number of research workers at present arranged for is eight—a number by far too small, one would think, for the requirements of the many problems that present themselves for investigation. Let us mention only malaria, dysentery, cholera, kala-azar, ankylostomiasis, filariases, beri-beri. Let us consider any one of these diseases in its etiological, pathological, and therapeutic aspects, and the work before these eight researchers is immense. Further, teaching has to be carried on, which it is to be hoped that the research workers will not be called upon to undertake. However, great undertakings often have small beginnings, and we are certain that important results will soon be forthcoming as the result of this new development.

THE *Times* of November 20 published a rather flamboyant little article, headed "A Surgical Schism." This article said: "Not for half a century at least has the medical world been so sharply divided as it is to-day in regard to the question of the treatment of wounds." Now, it is exactly half a century since Lister, at Glasgow, in 1865, first ventured to treat a compound fracture by plugging the wound with a strip of rag soaked in undiluted and impure German creasote. Pyæmia and septicæmia and erysipelas were ravaging the wards of the old Glasgow Infirmary, and he, relying on Pasteur's work on the "germs of putrefaction," and knowing that creasote was a good "disinfectant," plugged a wound with it. That was the beginning of everything, exactly half a century ago. To-day, there are many methods, but they do not all contradict or exclude each other. Nobody wants to rob the soldier of his little tube of iodine, to be applied to a wound right away; nobody wants to rob him of his little packet of antiseptic or aseptic stuff for a "first dressing." But to this handy and clean use of "Listerism," many other methods have been added; the use of citrates to promote the outward flow of lymph, and the use of a vaccine against sepsis, and the use of a vaccine against tetanus. The use of drainage and drainage-tubes is centuries old, and Lister did more than most men to establish the principles of it. We must not imagine a sort of desperate squabble among our military surgeons, some of them throwing antiseptics to the dogs, and others flooding a big wound with strong antiseptics, and then stitching it up without drainage and sitting on it. The suggestion in the *Times* article that an acute controversy is proceeding upon these matters is unfortunate and misleading.

PROF. EDOUARD PRILLIEUX, member of the French Academy of Sciences, died on October 8, at the age of eighty-six, at his private residence at Maléclèche, near Mondoubleau, Loir-et-Cher. To students of mycology in this country his name has been familiar since the publication in 1897 of his "Maladies des Plantes agricoles et des arbres fruitiers et forestiers causées par des parasites végétaux." This book is endeared to the student by its clear style and the refreshing presence of some hundreds of original drawings reproduced faithfully by the engraver. Prof. Prillieux entered as a student in 1850 the "Institut agronomique" at Versailles, and on leaving, his first botanical work was the study of the "powdery mildew" of the vine—that *Oidium* which was then devastating the Continental vineyards. In his book we find a beautiful and faithful drawing of the perithecial stage of this fungus, first found in France in 1892. In 1874 he was appointed professor of economic botany at the Central School of Arts and Manufactures, and two years later, when the "Institut agronomique" was reconstituted at Paris, he was appointed there to the chair of botany. In 1883 Prof. Prillieux became "inspecteur général" in the department of botany, and in 1888 was nominated director of the Laboratory of Vegetable Pathology. In 1899 he succeeded to Naudin in the membership of the Academy of Sciences. Prof. Prillieux made numerous researches into the anatomy, morphology, and physiology of plants, but it was as an investigator into the diseases of plants that he became so well known, and this entitled him to his place as one of the founders in France of plant pathology. Articles from him on this subject appeared frequently in the *Annales des Sci. nat. botanique, Comptes rendus,* and *Annal. de l'Inst. Nat. agronomique.*

IN the October number of *Mind* (New Series, No. 96) Mr. C. D. Broad discusses, in an article which is interesting and suggestive to physicists, mathematicians, and psychologists, as well as to philosophers, the question: "Is our Space Euclidean?" He shows the necessity of distinguishing clearly what we mean by space as distinct from matter, and argues that points of space and their relations are timeless, and that space must be considered as homogeneous. Nor must we conceive space as something which we analyse out of a complex presentation as we do when we distinguish in a musical note pitch and loudness, but, on the contrary, it is something we add to the experienced facts, although not in the Kantian sense of an intuitive knowledge. He shows the inherent weakness, for purposes of ultimate truth, of the common psychological distinction between perceptual and conceptual space, since in one sense all spaces are both conceptual and perceptual. By *our* space we mean a space so constructed as to enable us to deal with the data of all senses and of all men. When we ask "Is our Space Euclidean?" we mean, subject to the conditions that space is to be changeless and

homogeneous and not to act on matter, and that matter is to move about in space, can we construct a system of physics which assumes Euclidean geometry for space and enables us to deal adequately and consistently with all the data that men of science agree to be most worthy to be taken into account?

IN the Annals of the South African Museum (vol. xv., part ii.), Rev. T. R. R. Stebbing publishes part 8 of his account of South African Crustacea, enumerating twenty-two species of macrurous Decapoda, half of which are described as new. In the family Hippolytidæ a new genus is founded, the name of which is the last term in a curious series of word-buildings. Risso established Lysmata, Stimpson founded Hippolysmata, and now Mr. Stebbing gives us Exhippolysmata for a species taken off the mouth of the Tugela River.

Amoeba proteus has been described and discussed in biological laboratories more fully perhaps than any protozoan. Yet Miss L. A. Carter finds several new and interesting points in its cyst, which are described and figured in the Proceedings of the Royal Physical Society of Edinburgh (vol. xix., No. 8). The cyst consists of two membranous walls outside which is an envelope formed of cemented fragments. In the reproduction of encysted individuals from seventy-five to one hundred young Amœbæ were formed by the familiar division-process.

AUSTRALIAN cattle may be affected by nodules below the skin caused by the presence of "nests" of small nematode worms (*Onchocerca gibsoni*). Dr. Georgina Sweet has lately investigated the occurrence elsewhere of such parasites (published by the Ministry of Trade and Customs, Melbourne). She finds that the identical species is present in cattle in the Malay countries, while other species of Onchocerca afflict *Bos indicus* and *B. bubalis* in India. The original host is believed to be the Indo-Malayan Gaur (*B. gaurus*), whence the parasites have been passed to cattle in the Malayan and Australian regions. Unfortunately the mode of transmission is still unknown.

SOME valuable notes on the reptiles of the Okefinokee Swamp of Florida appear in the Proceedings of the Academy of Natural Sciences of Philadelphia (vol. lxvii., part i.) by Messrs. A. H. Wright and W. G. Funkhouser. Their notes on the alligator (*Alligator mississippiensis*) are profoundly interesting. These animals are hunted for the sake of portions of their hides, and are decoyed to their doom at night by means of the glare from a lamp. As they rise to the surface, attracted by the light, they are shot. Particular attention is directed to the coloration of the young, which at first are transversely banded with bright yellow; these bands, however, slowly fade, and in the adult are wanting entirely. On the other hand, the dorsal tubercles of the neck are absent in the very young specimens. The notes on the habits of the lizards and snakes and the colour variation they present are no less valuable. Many features worthy of note are also recorded of the Chelonia of this swamp.

THE *Museums Journal* for November gives an admirable account of the newly-opened Bolling Hall Museum of Bradford. Until recently a private residence, the oldest portions of which date from the fourteenth century, it passed into the possession of the city of Bradford as a free gift from its owner, Mr. G. A. Paley. Much renovation has been done since the building came into the possession of the Corporation. Oak panelling of the seventeenth century had been painted over, ornamental ceilings were underdrawn with lath and plaster, elaborately-wrought mantelpieces had actually been covered to a dead surface with cement and painted to simulate stonework, while the original rooms had been subdivided till they were little more than cupboards. No more fitting home for a museum of archæology could be found than this, which has the further charm of standing in beautiful grounds. In this same number Mr. W. H. Mullens concludes his most readable history of the old Leverian Museum. His account of the dispersal of the collections contains some valuable facts not otherwise accessible.

TWO West African cereals of some importance, known by the native names of Iburu and Fundi, are described and figured by Dr. Stapf in Kew Bulletin No. 8. Iburu, *Digitaria iburua*, is grown as a field crop in the Hausa States, N. Nigeria. The spikelets are densely packed, and a single head may contain 1000–2000 grains, which only weigh 0·7 mgr. each, and more than 40,000 go to one ounce. Fundi, *Digitaria exilis*, has been known for some time as a cultivated cereal; the heads of grain are smaller than in Iburu, and the seeds lighter, as about 53,000 seeds weigh an ounce. Fundi, however, is in much more general use by the natives. It is cooked by being thrown into boiling water or used like porridge. It seems probable that it might be appreciated as a light farinaceous food if exported to this country.

FOREST Bulletins, Nos. 27, 28, 29, contain notes on blackwood (*Dalbergia latifolia*), dhauri (*Lagerstroemia parviflore*), and sundri (*Heritiera minor*) respectively. In each bulletin a section of the timber is mounted to show the character of the wood. The text comprises details as to the general distribution of the trees and particulars of their locality and habit in India. Then follow a description of the properties and uses of the timber, an account of the natural reproduction and rate of growth of the trees, notes on the distribution in the different provinces in India, methods of extraction, etc. Sundri is a valuable timber somewhat displaced by teak. Since the sundri and teak forests are not in the same areas, the former timber has escaped the notice of traders, but if extracted it would appear, from a trial sale in Calcutta, to offer prospects of a lucrative business.

THE forests of Victoria, Australia, form the subject of an interesting paper by Mr. A. W. Hardy, read before the Field Naturalists' Club, Victoria, the first part of which is published in their journal, *The Victorian Naturalist*, vol. xxxii., No. 5, 1915. In the opening historical survey it is pointed out that there was little exploitation of the forests until about the

year 1857, when the gold rush to Victoria commenced. Then a demand sprang up for timber for dwellings, culverts, fences, etc., resulting in a deplorable destruction of valuable trees. The huts built were only "wattle and daub" at first, and for these the pliable and tough branches of acacia were used. From this use the popular name wattle has been applied to the Australian acacia, and is in common use to this day. Now, with the establishment in 1907 of a proper State Department of Forests, the care of the timber is assured, and 4,000,000 acres, or 7 per cent. of the total area of the State, is a reserved forest area. An account is given of the different types of Victoria forest, which are characterised chiefly by different species of eucalyptus. Pure forests of one species of these trees are not common, though woods may often consist entirely of several different species of eucalyptus. In the highland glens of Otway and Gippsland groves of the myrtle beech (*Notofagus cunninghamii*) are to be found.

THE *Journal* of the College of Agriculture, Tokyo, for March 20, 1915, contains a short article by Dr. S. Honda on the maximal growth of Japanese timber trees. Dr. Honda's article is illustrated by some excellent photographs of famous Japanese trees. The sacred tree of Arisan in Formosa (*Chamaecyparis formosensis*) attains the height of 40 metres, while the seven-forked Cryptomeria of Takaoka reaches 36 metres.

An extensive paper by Dr. S. Kusano, entitled, "Experimental Studies on the Embryonal Development in an Angiosperm," appears in the *Journal* of the College of Agriculture, Tokyo, for March 20, 1915. The paper is an elaborate study of the reproductive processes in a saprophytic orchid (*Gastrodia elata*), combining the methods of cytological study and experimental or field work, which, as the author says, "are in most cases not well co-operated." As in some other orchids, the embryo-sac has only four nuclei, instead of the usual eight. Triple fusion takes place, but no endosperm is formed. The nuclei in the embryo-sac, which ought to be haploid, are frequently found to show the diploid number of chromosomes (sixteen to eighteen). This points to the possibility of parthenogenesis (apogamy), which, however, could not be induced experimentally. The unpollinated flowers may develop dehiscent capsules and externally normal seeds, but no embryo. Development is further stimulated by certain foreign pollen (especially that of the orchid Bletia), but fertilisation is not effected. The nucleus of an unfertilised egg was sometimes observed to divide; here the nucleus was haploid, so the case was one of incipient true parthenogenesis, as distinguished from apogamy, but it goes no further. Delay in pollination favours poly-embryony, the second embryo being derived from the synergid, which would otherwise provide the "upper polar nucleus." Self-fertilisation, though a chance occurrence in Nature, is quite effective.

IN the *Geographical Journal* for November (vol. xlvi., No. 5) Dr. C. Davison gives an account of the earthquakes in Great Britain from 1889 to 1914. During those twenty-six years the number of earthquakes was no fewer than 357, although not one was accompanied by crust displacements at the surface. Some years were rich in earthquakes, like 1912 with 74, or 1890 with 26, while others, like 1914, 1897, and 1899, had only one. Dr. Davison discusses at length some typical cases, and then the origin of British earthquakes in general.

THE Sahara in 1915 is the subject of a useful paper by Mr. F. R. Cana in the *Geographical Journal* for November (vol. xlvi., No. 5). The summary contains a good deal of information regarding recent French exploration, which is widely scattered and not easy to lay hands on, and it concludes with a discussion of the possibilities of the land. Mr. Cana estimates that over an area of 350,000 square miles, that is, about one-tenth of the Sahara, increased cultivation is possible, and would be profitable. A good deal of well sinking has been done by the French in the Algerian Sahara, with most satisfactory results. Railway extension to some of the larger oases would increase the export of dates.

THE theory that the upper layers of the atmosphere are ionised and therefore conduct electricity, first enunciated by the late Prof. FitzGerald in 1893, has been extensively utilised in recent years to explain the law of decrease of the intensity of radio-telegraphic signals with distance. In an article in the *Revue générale des Sciences* for October 30 Prof. H. Nagaoka, of the University of Tokio, attributes this ionisation to two causes. The first is the utra-violet light of the sun, which he believes is capable of ionising the atmosphere down to about 40 kilometres from the earth's surface. The second is the stream of electrons emitted by the sun, which, owing to the magnetic fields of the sun and the earth, describe paths far from straight and account for the ionisation of the upper atmosphere at night. The greater height of the reflecting layer at night and the consequent reduction in the number of reflections of the waves at the ionised layer and at the earth's surface account for the better transmission of signals at night. The under concave surface of the ionised layer above a station at which the sun is rising focuses the waves from the west near the surface of the earth, and so gives the good signals at dawn. A similar focusing of the waves from the east occurs at sunset. The effect of solar eclipses is explained in the same way, and Prof. Nagaoka points out that as the period of an electrical oscillation on the sun is 6·5 seconds, there should be a corresponding period in the stray signals at terrestrial stations. He hopes radio-telegraphic observers will succeed in detecting this period.

THE October issue of *Knowledge* contains an article on "Eutectics," by J. L. Haughton and D. Hanson. In addition to a clear account of the properties and structures of these important alloys, the authors give a series of eight photographs of typical eutectics. These photographs, admirably reproduced on a large scale from various originals, are amongst the finest illustrations of the kind that have been offered to the general public. The publication of such illustrations should go far to convince those who are interested in the industrial employment of alloys that it is worth while to study their structure and to make use of the

additional knowledge that has been rendered available during the past twenty years or so.

THE spontaneous racemisation of optically active compounds is discussed by S. Komatsu in the third of his "Studies in the Stereochemistry of Quinquevalent Nitrogen" (Mem. Coll. Sci., Kyoto, vol. i., No. 5, July, 1915). In the case of a typical optically-active iodide it was shown that fusion brought about the decomposition shown in the equation,

$$N(CH_3)(C_2H_5)(C_6H_5)(CH_2.C_6H_5)I \longrightarrow N(CH_3)(C_3H_5)(C_6H_5)+C_6H_4.CH_2.I.$$

On allowing the fused mass to stand for a few days the iodide was reproduced, but when purified by recrystallisation from alcohol it was completely inactive. In this way direct proof was obtained of the theory first put forward by Pope in 1899 to account for the autoracemisation of these compounds.

THE fifth part of the Memoirs of the College of Science, Kyoto (July, 1915), contains a complete investigation of the system: sodium sulphate–sodium chromate–water. It is shown that at 15° C. the decahydrates of sodium chromate and sodium sulphate are mutually miscible in all proportions. At 25°, however, the formation of these mixed crystals is limited to 34 mols. per cent. of the chromate. When more chromate is added, the mixed crystals are decomposed, and the anhydrous sulphate separates. On further addition of sodium chromate, a new salt appears, which is probably a hexahydrated chromate not possessing the power of forming mixed crystals with the sulphate at 25° C. Indications have been obtained of the possible formation of a double salt of the composition

$$2Na_2SO_4,Na_2CrO_4,30H_2O.$$

Attention may also be directed to a series of papers in part 3 of these memoirs on the alloys of (1) Sb and Te, (2) Te and Se, (3) Te and Sb, (4) Tl and Se. These include a complete investigation of each system from the point of view of the phase rule, and are illustrated by microphotographs of various alloys. The compounds detected include Sb_2Te_3, PbTe, Tl_2Se, TlSe, Tl_2Se_3, whilst Te and Se are shown to form two series of mixed crystals descending to a eutectic point at 95 per cent. Se and 130° C.

IN No. 3 of vol. i. of the Bacteriological Series of the Memoirs of the Department of Agriculture in India, Mr. N. V. Joshi claims to have isolated a new nitrite-forming organism from soil, differing morphologically from others hitherto known. Its thermal death point lies between 70° and 80° C., and its optimum temperature of action at between 25° and 35° C. An increased proportion of carbon dioxide in the atmosphere acts as a stimulus to the activity of this organism. 0·2 gm. of glucose in 50 c.c. of Omelianski's solution totally inhibits nitrite formation by this organism, and 0·2 gm. of asparagin greatly retards it. In solutions containing phosphates, ammonium chloride, ammonium sulphate, ammonium carbonate, asparagin and urea serve as sources of nitrogen; in the absence of phosphates, ammonium carbonate is the only substance which can be easily changed to nitrite.

IN a recent review of a small book called "An Introduction to Mining Science" (October 21, p. 198) it was pointed out that in this as in all works which propose to teach just such portions of science as find direct application to any branch of technology the educational benefit to be gained from a study of the science is deliberately sacrificed to expediency. One of the authors of this book has taken exception to this statement. We have no objection to putting his protest on record, but we are unable to open our columns to a discussion of the points raised by the review. Our reviewer holds—and most people will agree with him—that in teaching an art the proper understanding of which requires the knowledge of certain portions of pure science, one of two methods may be adopted: either the student may be taught the science as a systematic entity, and then taught the incidence of such portions of the science as bear upon the industry in question, or else the teaching may be restricted to such portions of the science as are required for the special purpose in view. The former method has a higher educative value than the latter, because the reasoning faculties of a student are educated by the systematic study of the science in its logical development, whilst the latter method, even though it might teach all the scientific facts that bear upon an industry, sacrifices the educative advantages of the former.

MESSRS. Longmans and Co. announce for publication in their series of *Text-books of Physical Chemistry* part ii. of "Electro-Chemistry," by Dr. E. B. R. Prideaux; "A System of Physical Chemistry," by Prof. W. C. McC. Lewis; "Practical Spectrographic Analysis," by Dr. J. H. Pollok; and "Crystallography," by T. V. Barker. In their *Monographs on Physics* will be issued, "The Emission of Electricity from Hot Bodies," by Prof. O. W. Richardson; "Electric Waves," by Prof. G. W. Pierce; and "Atmospheric Ionization," by Prof. J. C. McLennan.

MESSRS. WEST, NEWMAN AND CO. have nearly ready for publication, "Vigour and Heredity," by J. Lewis Bonhote. It will be illustrated by coloured and uncoloured plates and diagrams.

OUR ASTRONOMICAL COLUMN.

THE DECEMBER METEORIC SHOWER.—This notable stream is an annually recurring one like the August Perseids, and it will be visible this year at a period when there will be little interference from moonlight. The radiant point apparently moves from near *theta* to alpha Geminorum, and the activity of the display seems prolonged over nearly three weeks. More observations are required as to the place of the radiant on successive nights. As observed by Mr. W. F. Denning at Bristol, the smoothed positions are approximately as under:—

Nov.	25	91+33	Dec.	6	104+33
	26	92+33		7	106+33
	27	93+33		8	108+33
	28	95+33		9	109+32
	29	96+33		10	110+32
	30	97+33		11	111+32
Dec.	1	98+33		12	112+32
	2	100+33		13	114+32
	3	101+33		14	115+32
	4	102+33		15	116+32
	5	103+33		16	117+32

There is a companion shower, often rather strikingly visible at the same time, and its radiant point is about 10 degrees east of the chief system. It apparently shows a similar displacement to the eastwards at the rate of about 1 degree per day.

These showers from Gemini are sometimes extremely active, and on the night of the maximum, about December 11, furnish 20 or 30 meteors per hour for one observer. They have swift flights, not often with conspicuous trains or streaks, and are not recorded so easily and accurately as the meteors from Perseus in August or those from Leo in November.

COMET 1915*d* MELLISH.—Orbital elements for this comet have been calculated by Messrs. S. Einarsson and Alter, of the Berkeley Astronomical Department (Lick Observatory Bulletin, No. 273), from three observations made by Aitken on September 20, 21, and 23 :—

$$\left.\begin{array}{l} T = 1915 \text{ Oct. } 13{\cdot}3959 \text{ G.M.T.} \\ \omega = 118^\circ\ 50'\ 30'' \\ \Omega = 77^\circ\ 42'\ 52'' \\ i = 53^\circ\ 32'\ 41'' \end{array}\right\} 1915{\cdot}0$$

$$\log q = 9{\cdot}64669$$

Elements deduced by Messrs. Braae and Fischer-Petersen were given in this column for October 14. It is pointed out that the orbit plane is nearly the same as that of comet 1915, also discovered by Mellish. In the current number of the *Observatory* Dr. Crommelin states that the elements show a distant resemblance to those of the comet of 1402.

VISIBILITY OF MERCURY.—The last W. elongation (18° 49′) of this planet occurred on November 7, and although only two-thirds of the possible maximum, the planet was seen by Mr. H. E. Goodson from the Hill Observatory, Salcombe Regis, ten days later on the morning of November 17, just before 6.15 a.m., attracting attention as a *conspicuous* naked-eye object, less than 1° above the eastern sky-line in a moderately bright dawn.

THE LIGHT-CURVE OF RZ CASSIOPELÆ.—A number of minima of this important circumpolar short-period eclipse variable have been followed by Sig. E. Paci, at the Royal Observatory of Catania (*Mem. Soc. Spett. Ital.*, September). The measures were made by means of a Töpfer wedge photometer attached to a Cooke telescope of 15-cm. aperture. The mean light-curve is based on 2274 measures made during eight minima since last July, and the magnitude ranges from 5·9–7·8 in 2h. 45m.

RECENT SCIENTIFIC WORK IN ITALY.

SINCE the outbreak of war in August, 1914, up to the end of May last, when Italy entered into the struggle, the output of scientific work in Italy seems to have suffered but little from the general upheaval which has in other countries so largely disorganised scientific effort. The *Atti* of the Royal Academy of the Lincei, which may be taken as representative of scientific work in general, embracing as it does all the different branches, shows during this period very little falling off from previous years either in the number or quality of the papers published. This may be seen from a brief review of the contributions of general interest published in vol. xxiii., part ii., and vol. xxiv., part i., which cover this period.

Prof. C. Acqua (vol. xxiii., ii., p. 78) has an interesting paper on the artificial absorption of liquids by the aerial parts of plants, in which a description is given of the striking effects produced by allowing living plants to absorb nutritive solutions through the leaves or cut branches. Plants which ordinarily die down in the autumn were in this way kept in leaf throughout the winter by the absorption of saccharose, whilst in other cases plants placed in unsatisfactory conditions of growth, which ordinarily would cause rapid fading, were revived by administering sugar solutions through the leaves or stalks.

Dr. V. Paolini and R. Lomonaco (vol. xxiii., ii., 123) show that the green essential oil obtained from Italian-grown wormwood (*Artemisia absinthium*) contains about 10 per cent. of a mixture of α- and β-thujones, 48 per cent. of thujylic alcohol, either free or in the form of acetic, isovaleric, and palmitic esters, and smaller proportions of phellandrene, cadinene and a blue oil of undetermined composition.

From a study of the effect of very dilute acids on the germination of oats (*Avena sativa*), Prof. R. Pirotta (vol. xxiii., ii., 166) concludes that the anion and kation of the acid have distinct effects, both chemical and biological, on the plant; the hydrogen acts on the root, and the reaction is localised therein, whilst the effect of the anion is localised on the growing points. From a similar study made by Dr. F. Plate on the effect of the chlorides of the alkali metals on germination, it is seen that the chlorides produce very different effects from the corresponding nitrates, the difference being due to the presence of a different anion.

In two papers on the formation of hydrocyanic acid in plants, Prof. C. Ravenna (vol. xxiii., ii., pp. 222 and 302) points out that in the estimation of small quantities of hydrogen cyanide in such cases, it is preferable to use potassium chromate as an indicator in titrating with silver nitrate solution rather than to employ Liebig's or Denigès's method. It is shown by a number of experiments on *Phaseolus lunatus* that this plant on germination at first produces hydrogen cyanide in increasing quantities, but that after a time the amount falls off. This plant, therefore, is no exception to the rule formerly established by the author with regard to the course of formation of hydrogen cyanide by cyanogenetic plants.

Dr. A. Clementi (vol. xxiii., ii., 517 and 612) describes a new method of determining the action of arginase, based on the quantitative estimation, by means of the formaldehyde process, of the new amino-group formed by hydrolysis of the arginine to urea and ornithine. Arginase is shown to be present, not only in the press juice of the liver of mammals, but also in aqueous extracts of these. In a later paper Dr. Clementi (vol. xxiv., i., 352) shows that Sörensen's titration process in presence of formaldehyde can be applied to mono-substituted amino-acids, such as sarcosine; as slight hydrolysis occurs in such cases, it is, however, necessary, in order that the results correspond with the whole of the acid present, that alkali should be added up to the point when an intense red coloration is produced with phenolphthalein.

Dr. Eva Mameli and Prof. G. Pollacci (vol. xxiv., i., 966) deal with the question of the direct assimilation of atmospheric nitrogen by plants. As the result of numerous analyses conducted under a system of rigorous control, it is concluded that the faculty of assimilating nitrogen directly from the air is far more widely distributed among plants than has hitherto been admitted. Nearly all chlorophyll-containing plants, from algæ to phanerogams, can, under special conditions, make use with greater or less activity of the atmospheric nitrogen. This property is most strongly marked in the Hydropteridæ, such as *Azolla carolinianum* and *Salvinia natans*, and in *Lemna major* and *L. minor*, but phanerogams such as *Cucurbita pepo*, *Acer negundo*, and *Polygonum fagopyrum* also possess it.

A series of papers on the metabolism of amino-acids in the organism is contributed by Dr. U. Lombroso and his collaborators (vol. xxiv., i., 148, 475, 863, and 870). Dr. A. Clementi (vol. xxiv., i., 972) has studied the action of proteoclastic enzymes on polypeptides, and (vol. xxiv., i., 55) the introduction of the guanidine nucleus into the molecule of polypeptides and its significance in physiology.

Amongst papers in pure organic chemistry, the following may be mentioned. E. Sernagiotto has studied in detail *carvone camphor*, a substance formed by the isomeric change of carvone when exposed to light in aqueous alcoholic solution. A. Angeli deals with the properties of certain azoxyphenols and of certain aldehydic compounds, V. Paolini and L. Devizia with the isomeric linalools and the resolution of the inactive form into its optically active components. L. Mascarelli and F. Negrisoli describe the resolution of decahydroquinoline into its optical antipodes.

In inorganic chemistry, Dr. G. Ponti describes investigations of the exhalations from Mount Etna; L. Cambi and G. Sperone have studied the properties of calcium amalgam and give measurements of its electromotive force. The electromotive force of magnesium amalgam forms the subject of a separate paper by L. Cambi.

In physics, A. Lo Surdo has studied the electrical field in the Hittorf-Crookes space, and the electrical decomposition of spectral lines. A. Venturi gives measurements of gravity carried out in Sicily in 1910, and U. Cisotti contributes a mathematical study of new types of permanent periodic and rotational waves. G. C. Trabacchi deals with the Hall effect in alloys of tellurium and bismuth, and P. Cardani describes a method of stabilising the action of Röntgen tubes by absorption of the carbon dioxide.

In the biological sciences, B. Grassi deals with phylloxera, G. Tizzoni with the significance of polymorphism in identifying the streptobacillus of pellagra, and R. Perotti with the morphological variation of *Mycoderma vini*.

W. A. D.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

AFTER the president's address the reports of several research committees were received. Prof. Waller demonstrated a small apparatus he had devised for the convenient administration of known percentages of chloroform. The regulation of the dose is easily effected, and anæsthesia may be safely induced by the patient himself, the mask falling off the face when the patient is sufficiently under chloroform.

In the report of the committee investigating the electromotive phenomena of plants Prof. Waller described an electrical method of testing the vitality of seeds. The size of the electrical response is directly proportional to the amount of vitality. The method is a great improvement upon existing methods, and should prove of commercial value in the testing of seeds.

Prof. Moore gave a paper on the action of light upon certain inorganic and organic substances. He reviewed the action of chlorophyll in photosynthesis, and showed how similar action could be obtained by the use of inorganic salts in place of chlorophyll. Prof. Moore found that acid salts, and especially iron salts, are most effective, the action being greatest when the colloidal surface is at a maximum. Chlorophyll itself is not the essential element in photosynthesis, but the colloidal salts in the chloroplast. Iron salts are abundant in many of the lower plants, and enable these to make use of the action of light.

Dr. T. W. Edridge-Green, in a communication entitled "Some Fundamental Facts of Vision and Colour Vision," attacked the prevalent assumptions that the rods of the retina are percipient elements, and that there are fundamental colour sensations which by their mixture give rise to other colour sensations. He adduced a number of arguments which he considered destructive of these theories.

Dr. T. W. Graham Brown then illustrated by lantern slides the effects of removal of the post-central gyrus of both sides of the brain upon the movements of a chimpanzee. Shortly after operation the chimpanzee was able to swing from the bars of the cage, using either hand with no sign of inco-ordination. A month after operation the animal showed no symptoms, was able to choose the right key from a bunch, insert it in the keyhole, and unlock and open the door of its room.

Prof. Herring described the effects of thyroidectomy and thyroid-feeding upon the adrenin content of the suprarenals. The adrenin was tested by the action of extracts of the suprarenals upon the blood-pressure of pithed cats after the method employed by Elliott. In a further series the amount of adrenin was measured by Folin's colorimetric process, and expressed in amount per kilo. body-weight. Thyroidectomy reduced the adrenin content considerably, but, when compared with the adrenin content of control animals similarly operated on except for the thyroids being left, it was found there was little difference. In animals which tolerate thyroidectomy, *e.g.* rabbits, there was little difference between the adrenin contents of thyroidectomised and control operated-upon animals a month after operation. Thyroid-feeding, on the other hand, in every case increased the adrenin content above that of the normal animal, and extracts of the suprarenals from thyroid-fed animals gave greater effects upon blood-pressure than similarly prepared extracts from the suprarenals of normal animals.

On Thursday Prof. Bayliss opened the day's proceedings by a paper on "The Mode of Action of Urease." He finds that urease is active in solutions in which it is insoluble, *e.g.* strong alcohol, and therefore acts at its surface by adsorbing urea. Water increases the rate of reaction by mass action or by the intervention of molecular forces in the act of condensation. On this assumption the action of various substances on the rate of reaction may be explained in two ways. The one action changes the degree of colloidal dispersion, and so alters the extent of active surface. Electrolytes show this action either by increasing dispersion and so accelerating the reaction, or by decreasing the surface by aggregation or incipient precipitation and so retarding the reaction. Weak acid and phosphate accelerate the reaction by increasing dispersion; multivalent ions, such as lanthanum, retard the reaction. The other effect may be explained by the substance taking possession of the surface and displacing the urea from it. This is shown by the so-called "surface-active" substances such as amyl alcohol, bile salts, and saponin. Surface energy is depressed and has a negative temperature-coefficient, and Prof. Bayliss finds that the retardation of reaction is greater at low than at higher temperatures. Adsorption of urea by the urease also explains the ratio existing between the concentration of the enzyme and its activity, together with the constancy of the rate of reaction above a certain concentration of the substrate, the latter being due to saturation of the surface. Concentrated solutions of urea greatly retard the action of urease and other enzymes. This is not explained by viscosity or want of water, but is

probably due to some action related to the solvent properties of urea. All attempts at synthesis of urea by urease failed. Prof. Bayliss referred to the complexity of the process of hydrolysis of urea, and believes that the first action of urease on urea is to form ammonium cyanate. The change of ammonium carbamate to carbonate is not accelerated by urease. An interesting discussion of problems raised by the paper followed, in which Prof. Ramsden and Prof. Moore took part.

Dr. J. Tait gave a communication on capillary phenomena in blood cells, and on phagocytosis. He described the movement of the spindle-shaped cells of invertebrate blood in coagulation, and pointed out their analogies with blood platelets. Such cells are phagocytic, but not amœboid; their movement is irreversible and passes into cytolysis. Dr. Tait proposes the name "Thigmocyte" for this class of blood cell. If the thigmocyte is unstable for any substance it is phagocytic for that substance. The movement may be explained physically, and obeys the laws of capillary attraction. Leucocytes, on the other hand, may be stable on a foreign substance, and yet be capable of ingesting small fragments of that substance. Dr. Tait showed that this is not inconsistent with a physical explanation. He further proposed a physical explanation for various blood phenomena, amœboid movement, diapedesis, the relation between agglutinins and opsonins, and the coagulation of blood.

Dr. C. E. Lea showed lantern slides of electrocardiograph records from clinical cases of auricular fibrillation of the heart, and pointed out the value of this method as a mode of diagnosis. The action of drugs on the condition was also illustrated.

Dr. E. P. Poulton read a paper on the alleged acid intoxication of diabetic coma. He analysed a series of cases showing the amount of alveolar CO_2 and the hydrogen-ion in the blood. Dr. Poulton finds no evidence of acid intoxication in diabetic coma; the blood, indeed, shows no increase in H-ion concentration in this condition, and is less acid than in uræmia, or even after moderate exercise. He believes the coma of diabetes to be the direct action of some poison, possibly acetoacetic acid. The lowering of the alveolar CO_2 may be to some extent responsible, and is in itself a trustworthy index to the onset of the condition.

Prof. W. H. Thompson recorded some experiments upon arginine and the formation of creatine. He fed or injected dogs and ducks with arginine, and estimated the output of creatine. In nearly all cases there was an increase of the creatine-creatinine output, injection giving the higher result. Racemic arginine gave no greater effect than dextro-arginine.

Prof. Thompson also contributed a paper on the effects of tetanisation on the creatine and creatinine in the muscle of the cat. A decerebrate animal was used and the creatine estimated by Folin's method. There was an apparent decrease as the result of long-continued activity of the muscle, but Prof. Thompson did not believe there was any real alteration, the apparent decrease being explained by other factors.

On Friday Dr. C. Powell White described a test for copper sufficiently delicate to detect 1/100th of a milligram in 15 c.c. of fluid. The test is identical with Oliver's test for morphine. Dr. Powell White found copper in all the tissues of the body and in various foodstuffs, animal and vegetable. Quantitative measurements were made by the ferrocyanide method. The copper may possibly play an important part in the reactions taking place in the living cell.

Dr. Lamb and Mr. Holker reviewed a number of methods of differentiating fats and lipoids microchemically, and showed lantern slides of tissues thus treated.

Dr. Lamb also illustrated the appearances of the mucous membrane of the small intestine during fat absorption, and showed differences in the columnar cells according to the kind of fat that was administered.

Dr. Sarah M. Baker propounded a new theory of muscular contraction which she termed the "liquid pressure theory." The theory was arrived at in consequence of a similar explanation of the ascent of sap in trees. An aeropermeable membrane, impermeable to liquids but permeable to gases, is assumed to be present in muscle. Carbohydrate is oxidised in the muscle with the production of water and CO_2. The formation of water causes a liquid pressure which manifests itself as a contraction of the muscle. Relaxation is due to rapid evaporation of water through the membrane. The heat thus lost reduces the total energy of the oxidation process by about nine per cent. Dr. Baker cited a number of observations supporting various points in the theory. In the discussion that followed, Prof. Thompson and Prof. Herring criticised the application of this theory to muscle in several details, and Dr. Baker replied.

Dr. Tait and Dr. Harold Pringle then gave a paper on the elasticity of the strophanthinised heart. Tracings of an isolated frog ventricle in Schäfer's plethysmograph were exhibited by the lantern, and the action on it of strophanthin demonstrated. The amount of relaxation of the ventricle was shown to be directly proportional to the preceding contraction, and to be entirely due to the elasticity of the heart.

BOTANY AT THE BRITISH ASSOCIATION.

THE meeting this year was a busy and successful one, though the attendance was smaller than it would have been in happier circumstances, many members being prevented from attending by more urgent calls and duties.

The shadows cast over the meeting by the war were deepened for Section K by the news of the premature death of Prof. D. T. Gwynne-Vaughan, who had been for many years successively secretary and recorder of the section. On Wednesday morning the section adjourned as a mark of respect during the hour of the funeral. A new departure which proved of value scientifically was the setting apart of an afternoon in which readers of papers demonstrated their results, and others also gave demonstrations. It afforded an opportunity for informal discussion which was greatly appreciated. No sectional dinner or excursions were arranged.

The presidential address has already been given in an abridged form in these pages. It embodied a plea for the revival of the causal point of view in morphology, so long neglected in favour of the phyletic aim. Using the alternating generations of the fern, the seed and its embryo, and other examples, the president illustrated the application of distinctively morphological conceptions, such as specific substance, with "allotropic" forms, and the correlation or mutual influence of parts, to the study of form and structure, and emphasised the significance for causal morphology of "homologies of organisation," which have been the bugbear of phyletic morphology.

A feature of the meeting very appropriate in Manchester was a lecture by Mr. Lawrence Balls on the application of science to the cotton industry. Surveying the chief results of his experimental study of the cotton plant in Egypt, he showed how, by suitable sampling, trustworthy statistics could be obtained, from which the growth, flowering, and fruiting of an average plant under average conditions could be cal-

culated. Such data, graphically represented, showed in a striking way correlations between flowering, fruiting, and growth, which might enable an expert to issue at frequent intervals valuable reports and trustworthy forecasts that would have a steadying effect on the market. The lecturer also indicated how careful breeding and selection of pure strains could result in improved spinning quality. Pure strains yield more uniform lint, which will spin well even in cases where the expert grader would reject a sample at first sight as worthless. The need of closer co-ordination between the grower and spinner was emphasised, the chief desideratum being a common language, which might be provided by men of science, so that the spinner could make his requirements intelligible to the grower.

Cryptogams.

Prof. F. O. Bower gave an account of the progress which has been made since the publication of his "Origin of a Land Flora" in the study of the relationships of the Filicales, with special reference to the Dipterids and Pterideæ. While dealing with these in detail he gave a general account of the present state of knowledge with regard to the phylesis of the ferns as a whole. Members of the section appreciated the opportunity of learning the direction in which investigations still in progress at Glasgow were pointing.

Prof. T. G. B. Osborn sent a paper describing the morphology and structure of *Selaginella uliginosa*, which occurs in eastern Australia. It has a well-developed rhizome in which the vascular system is solenostelic, with ramular gaps, a second example of solenostely in the genus. In relation to this Mr. H. B. Speakman demonstrated the structure of the branching rhizome in *Selaginella lyallii*.

Prof. A. H. R. Buller described the discharge of spores from the basidia of Uredineæ and Hymenomycetes. The discharge is violent, a drop of fluid being previously excreted just below the spore, and discharged with it. In many cases the basidia are curved so as to direct the spores towards the open air. Dr. M. Wilson recorded the occurrence of the conidial stage of *Tuburcinia primulicola* on *Primula vulgaris* in Kent. The conidia appear as meal-like masses, partially filling the corolla tube and gluing the stamens together. Conidia may be found in all stages of conjugation by short connecting tubes. Germ tubes are afterwards produced, which probably develop the mycelium that bears the chlamydospores. These arise in groups from coiled masses of hyphæ, and when young contain conjugate nuclei which afterwards fuse. Finally, the whole ovary disintegrates, setting free the spores as a black powder. Mr. W. Robinson demonstrated germ tubes of certain Uredineæ, and abnormal spermogonia.

Fossil Botany.

Dr. Marie C. Stopes gave an account of the remarkable flora of the Lower Greensand deposits of Aptian age, represented by petrifactions, often beautifully preserved, as was amply demonstrated by lantern-slides and actual sections. The flora included Cycadophyta, Conifers, and woody Angiosperms. The wood gives evidence of well-marked seasons, pointing to a cool climate, in marked contrast to the "tropical climate" inferred to have existed at the time of the Wealden flora of southern England.

Prof. F. W. Oliver showed slides illustrating the structure of the seed Gnetopsis, which he has recently further elucidated, and dealt with some general problems of the seed and the flower. Prof. D. Ellis described fungal hyphæ occurring in ferruginous rocks of the Lower Lias, which were incrusted with ferric hydrate, unseptate, with branches, frequently in whorls, and spherical sporangia, each containing about four spores. Another similar fungus, from secondary rocks in north-west Scotland, had a hard black membrane and no sporangia. In fossilised putrefying animal remains were found two Bacilli, a Micrococcus and an Actinomyces-like form, consisting of a thick meshwork of minute threads.

A paper was contributed by Mrs. Edith M. Osborn describing an Australian Zygopteris, probably of Upper Devonian age. This new type is of extraordinary interest. It combines the main features of the *Ankyropteris grayi* type of stele, with the simple Clepsydropsoid type of petiolar structure. Axillary branches were not present. Miss N. Bancroft demonstrated sections showing the structure of the stem and petiole and the mode of branching of *Rachiopteris cylindrica*.

Physiology.

Miss T. L. Prankerd described observations, similar to those of Haberlandt and Nemec, on the coincidence in time and place of geotropic sensitivity and the occurrence of movable starch grains ("statoliths") in certain Liverworts and other plants, illustrated by good microphotographs. Movable starch was located in the top point of the curve of young circinnate fern fronds. In general the nuclei of the "statocytes" were larger than those of neighbouring cells, and in many cases were found among the starch grains at the bottom of the cells.

Dr. Sarah M. Baker directed attention to the enormous fund of energy represented by the total internal liquid pressure of water (corresponding to the pressure of a gas, due to molecular bombardments), which, according to Van der Waals and Stefan, reaches many thousands of atmospheres at low temperatures. Just as osmotic pressure becomes effective in presence of a semi-permeable membrane, so might liquid pressure theoretically become effective, given a membrane permeable to water vapour, but not to liquid water. Dr. Baker suggested that this liquid pressure might account for the ascent of water in tall trees, adducing as evidence of the existence, in the growing region of the root, of a membrane with the requisite properties, (1) that certain dyes do not enter this region, in contrast with the root-cap and root-hairs, and (2) that in a moist atmosphere acid drops of water exude from the root-hairs. The interpretation placed upon these facts was received with some scepticism; it was, moreover, objected that the relatively low values hitherto obtained for root-pressures and the existence of "negative" pressures in the trunks of trees during active transpiration make it abundantly evident that the pumping activity of the root, however it may be explained, is not adequate to the raising of water as fast as the shoot-system actually absorbs and transpires it. On the other hand, attention was directed to the desirability of more extended observations of root-pressures in relation to the heights reached by different species.

Dr. E. M. Delf gave a preliminary account of very careful experiments by a new method on the effect of temperature on the permeability of protoplasm. The rate of contraction (proportional to the rate of exosmosis of water) of strips of plant tissue was followed minutely, and the rate at a specified stage of the contraction was taken as a relative measure of the permeability to water. The results showed a much greater rate of increase at high temperatures than hitherto observed, the curve being logarithmic in form right up to 42°.

Mr. A. M. Smith dealt with the effect of drying on the respiration of plant organs. His experiments showed that with the removal of increasing percentages

of contained water the respiration increases regularly up to 25–30 per cent. loss, when it reached two or three times the respiration of similar undried material. Beyond this point drying had no further effect until 50–60 per cent. of the water had been removed, after which the respiration steadily diminished, not ceasing entirely so long as any water remained in the material.

Prof. W. B. Bottomley gave the results of relative determinations of growth-stimulating "auximones" by means of the bacterial scum formed in their presence on crude nitrifying culture solutions. The relative amounts in fresh and rotted manure and bacterised peat respectively were 1, 5, and 250. The formation of auximones during germination was demonstrated; excised embryos were found to flourish in culture solutions only if auximones were added. Culture experiments with *Lemna minor* showed that the purer fraction precipitated from extracts by silver nitrate stimulates growth more than the cruder phosphotungstic fraction.

Other Papers.

The only foreign guest of the section, Prof. Julius McLeod, of Ghent, demonstrated the possibility, in the case of certain mosses, of describing and determining species biometrically. Using the genus Mnium, as an example, the maximum, mean, and minimum values for the length, breadth, etc., of the leaves on successive portions of the fertile stem up to the longest leaf were tabulated. The results showed that the correlation between these measurements was characteristic of the species, so that by comparing the length, breadth, etc., of, for instance, the longest leaf of a given specimen with data for the longest leaves of the various species, it could be identified.

Dr. J. C. Willis put forward the view, based on a statistical study of the flora of Ceylon and India, that very local indigenous species are those of recent origin, while species widely distributed on the mainland as well, are those long established. He found no evidence of the elimination of species by "natural selection"; most of the widely distributed species are also common, few rare, while of the endemic species the majority are rare.

Dr. E. J. Salisbury described the influence of coppicing on the ground flora of Oak-Hornbeam woods on clay soils. Before coppicing, it comprises chiefly perennial herbs with storage organs which produce their leaves very early in the spring. After coppicing, species from the edges of the wood and paths invade the opened areas, accompanied by weeds of cultivation with good dispersal mechanisms. Some of the old occupants are enabled by the increased light to flower. The soil becomes more acid and drier. The gradual return of the ground flora to its original condition as the undergrowth thickens was described.

In addition to the contributions already mentioned, Mrs. M. G. Thoday demonstrated the structure of seeds of *Gnetum gnemon*, Miss E. M. Blackwell dealt with the occurrence of stomata on hypogeal cotyledons, and other smaller demonstrations were given.

Reports.

Reports on the work of committees of the section were submitted as follows:—By Prof. T. G. B. Osborn, on the cutting of sections of Australian fossil plants; and on Australian Cycadaceæ; by Prof. A. J. Ewart, on investigations of the influence of various atmospheric pressures upon geotropic and heliotropic irritability and curvature; by Mr. R. S. Adamson, on the vegetation of Ditcham Park, Hampshire; by Prof. R. H. Yapp, on the Cinchona Botanic Station in Jamaica; and by Mr. R. P. Gregory, on experimental studies in the physiology of heredity.

AGRICULTURE AT THE BRITISH ASSOCIATION.

ALL interest in agriculture centres at the present time in the economic problems involved in the desired increase of the scope and efficiency of British farming as measured by its output of foodstuffs. It was inevitable, therefore, that the programme of Section M. this year should be largely devoted to the consideration of the existing situation and of the economic factors which govern the introduction of changes in the direction of increased production.

The inaugural address of Mr. Rew, apart from its other merits, served to give the section at the very outset an admirable *résumé* of the existing situation as regards the share contributed by British agriculture to the national food supplies, and more particularly the extent to which it has assisted during the past year in making good the lack of supplies from sources cut off by the war that under normal conditions would have furnished us with some portion of our food. He was able to renew the assurance given by him three years ago at Dundee that, even in normal times, the share of British agriculture in the food supply of the nation is more considerable than is commonly realised. Further, he could demonstrate that this share has been substantially increased during the first year of war, whilst, thanks to the Navy, the total supplies which have reached our shores have been actually rather larger in time of war than in time of peace.

After the address, reports upon the present situation and outlook with reference to supplies of manures and feeding-stuffs were presented by Prof. Hendrick and Mr. E. T. Halnan. Prof. Hendrick directed attention to the difficulties that were likely to arise in connection with the supplies of phosphatic manures, especially "dissolved" manures, owing to the increased cost of imported raw materials and the difficulties of distribution. The loss of supplies of potash manures from Germany could be met only to a very slight extent from other sources, but much might be done to reduce existing waste of potash in the form of loss of liquid manure. The exploitation of seaweed as a source of potash and iodine was also worthy of attention. In a later paper Prof. Hendrick quoted numerous analyses of seaweeds, both Fucus and Laminaria, which showed that the latter contain appreciable quantities of potash, amounting in some cases to fully 12 per cent. of the dry matter.

Mr. Halnan dealt more particularly with the supply of feeding-stuffs, and summarised the results of tests made at different centres with materials new to the British market, such as dried yeast and palm-nut kernel cake.

A further contribution to this day's programme was made by Prof. Somerville, who gave the results of a series of pot-culture experiments which demonstrated clearly the accumulation of fertility in the grass-land of five selected farms as a result of the application of basic slag.

The second day's programme furnished a natural corollary to Mr. Rew's address in the shape of a discussion of various aspects of the present and future agricultural situation as affected by the war. For the purposes of this discussion Mr. T. H. Middleton, Permanent Under-Secretary of the Board of Agriculture and Fisheries, opened the day's programme with an interesting comparison of the efficiency for the production of food of different systems of farming. By ingenious methods of computation he was led to the conclusion that, whereas grazing at its best produces probably not more per acre than sixty-seven days' supply of protein, or 140 days' total supply of energy for a man, and, at its worst, produces no

more than eleven days' supply of each, dairy farming on grass of good quality might be expected to produce 296 days' supply of protein, or 193 days' total energy supply, whilst arable farming on good land producing food crops and meat would give 207 days' supply of protein, or 296 days' total energy supply. Where grass land is attached to the arable land, and all the feeding materials are converted into milk, the energy value of the arable farm is increased to 367 days' food supply, and the protein yield to 383 days' supply. Viewed from this standpoint, the need for a great extension of arable cropping admits of no argument. "Can the nation any longer afford to neglect the development of the resources now lying latent in its unproductive grass land?"

Mr. J. M. Caie, of the Scottish Board of Agriculture, followed with a paper on "The Probable Effect of the War on the Future of Agriculture in Scotland." After reviewing the salient features of Scottish agriculture and the tendencies of comparatively recent changes prior to the outbreak of war, he outlined the principal economic causes that would tend during and after the war to decrease the demand for and lower the prices of agricultural produce. On the other hand, certain other causes would be operative in diminishing supplies, or otherwise raising prices. Balancing these two sets of factors, he inclined to the opinion that prices, both of bread and of meat, will be relatively high, and that, though costs may also be high, increased production will be economically advantageous to the farmer. He did not think that Scottish agriculture would contribute a materially increased output of wheat, since conditions of soil and climate impose severe limitations, but there is room for expansion in the numbers, and improvement in the quality, of stock. In conclusion, he indicated the factors which would be operative in bringing about this increase of numbers.

Prof. T. B. Wood next spoke on the ways in which the agricultural man of science can assist the stock-feeder in utilising existing conditions to the best advantage. He instanced the introduction of new feeding-stuffs and the prevention of waste in feeding as matters in respect of which the scientific adviser can give immediate and trustworthy guidance to the farmer.

The subject of labour and labour-saving machinery on the farm was dealt with by Mr. W. J. Malden. He emphasised the importance of early-training of the agricultural labourer, and urged the desirability of a reform of educational methods in the rural school with this end in view. The development of the use of machinery on the farm would be more rapid when the implement-maker and the motor-maker joined hands. Confused ideas which the effort to adapt attachments suitable for horse-power, but utterly unsuited for mechanical power, have established must be cleared away.

In the discussion which followed the foregoing papers, Prof. W. H. Thompson gave an account of his own estimates of the food production of Irish agriculture which led to conclusions similar to those arrived at by Mr. Middleton.

A paper on the economics of continuous cropping was subsequently given by Mr. Thomas Wibberley, in which he outlined the results obtained by him on various farms in Ireland and elsewhere by following a course of continuous cropping. He claimed that his system obviated certain practical difficulties of cultivation that beset the ordinary systems, and that it was not only more lucrative and more economical of natural resources, but led to a considerable increase in the output of food. The subject is one of great interest, and it is to be regretted that limitations of time did not permit of a fuller discussion in the section.

The third day's programme was designed to be of special local interest, and was devoted largely to problems of milk-production. One contribution which did not come under this head was the paper by Mr. D. Macpherson and Dr. W. G. Smith on the classification, economic value, and possibilities of improvement of the upland grazings of Scotland. Five types have been recognised, and their distribution and characteristics closely studied. Methods of improvement were indicated and discussed.

Of the milk papers, attention was directed specially to two dealing with the problem of the assessment of the cost of feeding in the production of milk.

Mr. J. Mackintosh gave an account of the methods adopted at University College, Reading, in connection with investigations on farms in the surrounding area. The outstanding point of difficulty is the assessment of the cost of the home-grown foods consumed by the cows. At Reading these foods are charged at the estimated cost of production, whereas in certain cases elsewhere market or consuming price is charged. The effect of this divergent practice upon the results arrived at was well illustrated in the succeeding paper by Prof. Crowther and Mr. Ruston on the results obtained on three Yorkshire farms. They showed that whereas the estimated cost of food consumed per gallon of milk produced was roughly 3¼*d.* when home-grown foods were charged at cost of production, the estimate was increased to roughly 5*d.* when an arbitrary scale of "consuming prices" was used for these foods. The subsequent discussion centred mainly round this point, and showed considerable division of opinion. Mr. C. S. Orwin urged strongly the desirability of the universal use of the cost of production of the home-grown foods as the basis of assessment, but practical farmers who took part in the discussion inclined mainly to the opposite view that market prices should be charged.

Subsequently Dr. A. Lauder gave an account of experiments in which the effects upon milk-secretion of an addition of calcium phosphate to the food of cows had been studied. In no case could any measurable effect upon either the yield or the composition of the milk be detected.

Prof. Crowther gave an account of experiments which seemed to indicate that the act of milking may be of considerable significance in determining the yield of milk, and especially of milk-fat obtainable at any particular milking. When the "quarters" were milked separately he found that, whereas in the case of the first quarter the percentage of fat in the secretion rose in the main steadily from beginning to end of the milking, this was not the case with the other "quarters." No matter in what order the "quarters" were milked, the percentage of fat was almost invariably lowest in the milk drawn from the quarter milked last. These observations led to the conclusion that the time-factor in milking must be of considerable importance. This was confirmed by an experimental comparison of quick and slow milking. A further comparison of the ordinary method of milking and simultaneous milking of the four "quarters" showed a difference in favour of the latter, which might in practice be appreciable if certain mechanical difficulties were overcome.

The concluding paper of the programme by Mr. A. G. Ruston on "The Plant as an Index of Smoke Pollution" introduced another problem of great local interest. Mr. Ruston dealt with the general type of vegetation in smoke-infested areas, the general appearance of individual smoke-damaged plants, and the specific effects of smoke-damage in plants. His remarks were based upon the work on the subject which has been carried out by him and others during the past

seven years in the agricultural department of the University of Leeds, and were well illustrated by lantern slides. Results were quoted showing a direct correlation between the degree of atmospheric pollution and the activity of plant-growth, the chemical composition of the plant, the activity of the plant enzymes, and the vitality of the seed produced.

The meetings were well attended throughout, and the limited time available for discussion was fully utilised. The proceedings furnished, indeed, abundant evidence that, despite the special circumstances of the year, the steady development of the section is being well maintained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Senate of the University passed the following resolution at its meeting on November 17:—"That the Senate desire to express to Lady Rücker and her family their deep sympathy upon the death of Sir Arthur Rücker, who upon the reconstitution of the University in 1901 was appointed its first principal, and to assure them of their profound appreciation of the great services he rendered to the University during his seven years' tenure of that office."

OXFORD.—In the annual report recently issued by the Committee for Geography, after a sympathetic reference to the death of Prof. Herbertson, facts are given showing the steady progress of the school. This is evidenced not only by the increasing number of regular students, but also by the rapid growth of the collections of maps, books, and other apparatus bearing on the subject of geography. The emergency created by the death of the professor has been met for the time by the appointment as acting-director of Mr. H. O. Beckit, of Balliol College. Special provision for the wants of different ranks of H.M. Forces training at Oxford has been afforded by lectures and other teaching on the geography of the western war area, the influence of the geography of Greece, and military map-reading. These were given by the professor, Mr. Beckit, Prof. J. L. Myres, and Mr. Kendrew. Mr. A. G. Ogilvie, junior demonstrator, is attached to the staff of the Mediterranean Expeditionary Force in a geographical capacity. The report contains also a grateful acknowledgment of the proposal by the family of Prof. Herbertson to present to the school the considerable number of books lent by him to the library.

IT is announced in the issue of *Science* for November 5 that Mr. J. J. Hill has presented 25,000*l.* to Harvard University to be added to the endowment of the professorship in the Harvard graduate school of business administration which bears his name. The James J. Hill professorship of transportation was founded by a gift of 25,000*l.*, announced at the beginning of this session. The General Education Board announces that 20,000*l.* has been given to Carlton College, Northfield, Minn., toward a fund of 80,000*l.*; 10,000*l.* to Hobart College, Geneva, N.Y., toward a fund of 40,000*l.*; 40,000*l.* to Lafayette College, Easton, Pa., toward a fund of 200,000*l.*; and 5000*l.* to Kalamazoo College, Kalamazoo, Mich., toward a fund of 20,000*l.*

IN the course of the academic year 1914–15 a new department was established on a permanent basis in the Mellon Institute of Industrial Research of the University of Pittsburgh, namely, a Department of Research in Pure Chemistry. The headship of this department is to be known as the Willard Gibbs professorship of research in pure chemistry, "ever to proclaim the ideal which the incumbents of the chair and the groups of research workers to be associated with them will be expected to follow." It constitutes a chair in the graduate school of the University of Pittsburgh, as well as in the Mellon Institute. Dr. M. A. Rosanoff, who built up and for years was head of the graduate department of chemistry in Clark University, was formally inaugurated as the first permanent incumbent of this professorship, at a meeting held in the assembly hall of the Mellon Institute on October 26. Addresses were given by Profs. J. McKeen Cattell and M. T. Bogert, both of Columbia University, and by Dr. Rosanoff, followed by a reception and an inspection of the Mellon Institute. Chancellor S. B. McCormick presided at the meeting. He explained the circumstances connected with the establishment of the chair, and thanked the donors whose generosity had made possible the endowment, of which the income, amounting to 1000*l.* per annum, is to constitute the salary of the incumbent of the chair.

THE calendar for 1915–16 of King's College, London, contains detailed particulars of the courses of study provided in the various departments of the institution. The work at King's College in connection with the University of London consists of (1) University of London King's College, with faculties of arts, laws, science, and engineering; (2) King's College Theological Department; and (3) University of London King's College for Women. In the case of the College for Women, the arts and science departments were transferred to King's College, Strand, last January, and the Household and Social Science Department is now situated at Campden Hill, London, W. The faculty of engineering provides a systematic course of study of university character for those intending to devote themselves to engineering. It is so arranged as to give preparation for those wishing to take a degree in engineering at the University of London, and the diploma of the college. Owing to the removal of the Strand School, the engineering department has obtained additional accommodation. For electrical engineering a new lecture theatre and rooms for research, including wireless telegraphy, are provided. The new rooms are now ready for use, and the laboratories are well equipped with boilers, steam engines, gas engine, steam turbine, refrigerating and other experimental plant. The scientific principles which underlie all branches of engineering, together with the methods of applying those principles, are taught in carefully arranged and graduated courses. A noteworthy section of the calendar provides a list of original papers and publications issued by the various departments of the college during the year 1913–14; it runs to some nine full pages, and is excellent evidence of the facilities for research provided by the authorities.

IN March last, Mr. Asquith, in moving the second reading of a Bill to give emergency powers to university authorities, said:—"In no sphere of our national life has the war produced a greater change than in our two ancient Universities." Two recent articles in the *Morning Post* deal with some of the effects of the war on higher education, and serve excellently to demonstrate that not Oxford and Cambridge alone have responded patriotically and abundantly to the call to arms, but the newer universities have taken up the burden with equal manliness and energy. We have no doubt that when Scottish, Welsh, and Irish universities and those in more distant parts of the Empire are dealt with the author will be able to record an equally glorious response. The most conspicuous result of the war from the point of view of Oxford University has been the immense reduction in the number of undergraduates and of resident fellows of

colleges, fully two-thirds of the undergraduates who would otherwise have been in residence being absent on military service. The number of resident undergraduates in the University of Cambridge, which was 3306 in Michaelmas term, 1913, fell to 1658 at Michaelmas, 1914, and a still further decline was observable last term. The number was 1097 at the commencement of the term, but many had disappeared before the conclusion. A similar reduction in numbers is reported, in the articles, in the Universities of Birmingham, Bristol, Durham, Leeds, Liverpool, Manchester, and Sheffield. To mention a few instances: at Durham there are 573 students as against 947 in 1913–14; at Liverpool the undergraduates attending classes this session number 420 and the post-graduates 150, while in 1913–14 the numbers were 548 and 289 respectively; at Manchester there is a decline of more than 500 in the number of men students as compared with 1913.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 18.—Sir William Crookes, president, in the chair.—Lord **Rayleigh**: The theory of the capillary tube. In a recent paper Richards and Coombs comment on deficiencies in the mathematical treatment of the capillary tube, some of which it is here attempted to remedy. In the best experimental arrangement a wide and a narrow tube are connected below, and the difference between the levels of the lower parts of the two meniscuses is measured. In the interpretation of the results for deducing the surface-tension of the liquid, two problems arise (i) how to allow for the weight of the meniscus in the narrow tube, and (ii) to find what diameter is necessary for the wide tube in order that the elevation due to curvature of the liquid surface may be neglected. The first problem was considered by Poisson, but his results in the only really important case, viz., when the liquid wets the walls of the tube, have been disputed. Poisson's formula is here confirmed and extended. If r denotes the radius of the tube, h the measured height of the meniscus above the truly plane level, T the surface-tension, g gravity, and ρ the density of the fluid, $2T/g\rho.r = h + r/3 - 0{\cdot}1288r^2/h + 0{\cdot}1312r^3/h^2$, an approximation which should suffice for experimental purposes. It may be remarked that the first two terms on the right correspond to the assumption of a spherical surface, which is legitimate when r is small enough. A completely adequate solution of the second problem is more difficult. But it is easy to show theoretically that such diameters as are sometimes used for the wide tube (2·5 cm. or 3·0 cm.) are quite insufficient, at any rate in the case of water, a conclusion reached also by Richards and Coombs in direct experiment. It appears further that the widest tube used by these observers (3·8 cm.) would be insufficient to take advantage of the actually achieved delicacy of reading. An approximate calculation of the diameter necessary for this purpose gives 4·7 cm. —Prof. C. H. **Lees**: The effect of the form of the transverse section on the resistance to the motion of an elongated body parallel to its length through a fluid the viscosity of which is not negligible. When a very elongated body moves parallel to its length through a fluid, the resistance due to the viscosity of the fluid varies considerably with the form as well as with the magnitude of the cross-section of the body. Values of the total resistance and of the resistance per unit area of contact with the fluid are given in various cases. In all cases so long as the fluid is in streamline motion, the law of resistance can be expressed in a simple form, and it is desirable that measurements of the resistance when the motion is turbulent should be made in order to determine the extent to which these laws may be utilised in practical engineering.—Prof. J. **Joly**: A method of estimating distance at sea in fog or thick weather. The method proposed is based upon the different velocities of disturbances in differing media. If aerial and submarine signals are simultaneously emitted at a lighthouse station or lightship the lag of the aerial compared with the submarine sound is about 4·3 seconds to the nautical mile. An approaching ship picking up the signals and measuring the lag to an error even of one second becomes aware of her distance to less than one-quarter of a mile. Similarly, wireless signals and submarine signals, or wireless and aerial signals, may be used. If the faster-moving signals be sent out in groups, the individual signals being spaced to regular intervals—say, of one second—and the slower moving signal be always emitted simultaneously with the first signal of a group, the navigator has only to count the faster signals until the slower signal reaches him, in order to estimate his distance from the signal station. In this case the signals themselves tell him his distance, and no actual time-measurements are required on board ship. It is shown that this system enables the mariner to determine his position completely in all circumstances which may arise.—Prof. J. **Joly**: A method of avoiding collision at sea. This paper deals with an extension of the method described in the preceding paper for estimating distance at sea to the problem of avoiding collision in fog. It is shown that if vessels possess the means of emitting a loud and crisp sound signal which can be sent out simultaneously with a wireless or a submarine signal, the determination of distance rendered possible thereby, along with wireless information as to course and speed, will enable the navigator on each ship to determine with certainty (1) whether there is risk of collision or whether there is no risk, and (2) the point upon his own course and the moment at which collision is threatened. The solution of the problem is based upon the fact that at each instant the rate of mutual approach is the maximum if the ships are advancing so as to collide. A simple geometrical construction, which by its character is unlikely to involve error, enables the mariner to solve the problem immediately the signals are received.—S. W. **Richardson**: The flow of electricity through dielectrics.—S. **Chapman**: The kinetic theory of gaseous viscosity and thermal conduction, and the law of distribution of molecular velocities in the disturbed state. The first object of the paper is to determine the velocity-distribution function $f(u, v, w)$ in a gas in which there are small variations of temperature and velocity from point to point. Both simple and mixed gases are considered; the mixtures are supposed uniform, the study of diffusing mixtures being deferred to a later paper.

Zoological Society, November 9.—Dr. S. F. Harmer, vice-president, in the chair.—Dr. G. E. **Nicholls**: The anatomy of *Rana tigrina*, the so-called bull-frog of India. Attention was directed to certain features in which this species differs from its European congeners. —Dr. J. C. **Mottram**: Pattern-blending with reference to obliterative shading and concealment of outline. The paper recorded the results of laboratory experiments with artificial patterns. The experiments showed that obliterative, or counter-shading, could be produced by blended black-and-white pattern, and that beyond the blending distance, interruptions at the margin of a pattern, or similarly placed eye-spots, blur the margins. The laboratory experiments were compared with actual patterns of animals.—Dr. J. C. **Mottram**: The distribution of secondary sexual characters amongst birds, with relation to their liability to

the attack of enemies. The paper was based upon a statistical inquiry into the possible existence of a correlation between these factors.—C. Boden **Kloss**: Mammals from the coast and islands of south-east Siam. More than 500 specimens were collected by the author. One species and twenty-two subspecies were described as new.—Prof. W. J. **Dakin**: The fauna of West Australia. (Two papers.) The first paper contained the description of a new land Nemertean, the first to be recorded from West Australia. The second paper described a new prawn-like Crustacean of the genus Palæmonetes, which genus had not hitherto been recorded in Australia.

Mineralogical Society, November 9.—Mr. W. Barlow, president, in the chair.—W. **Barlow**: Crystallographic relations of allied substances traced by means of the law of valency volume. The ordinary parameters of a crystal do not necessarily express the actual ratio between the minimum translations of the crystal structure, and it is justifiable to multiply one or sometimes two of them by a small integer in order to obtain the equivalence parameters. A number of cases were taken which showed that in crystals which either contain the same radicle or closely related radicles the similar parts are arranged in identical strata intercalated between the remaining constituents of the crystal.—A. F. **Hallimond**: Torbernite. From measurements made on several specimens the axial ratio, $a:c=1:2{\cdot}947$ was determined, and the forms 001, 101, 103, 111, 112, besides vicinal faces, were observed. The mineral becomes unstable at vapour-pressures about one-third that of water, and passes into Rinne's meta-torbernite I. At higher temperatures the transition-curve rises sharply, and meets the vapour-pressure curve of water at 75° C., above which torbernite has no stable existence in air.—T. V. **Barker**: The solution of the problem of four tautozonal poles. The indices of two poles, C, D, may be expressed as functions of those of the other two, A(*abc*), B (*def*) in the form $(pa+qd,\ pb+qe,\ pc+qf)$, $(ma+nd,\ mb+ne,\ mc+nf)$, where p, q, m, n are small, positive or negative, integers. Since $np\cot AD=(np-mq)\cot AB+mq\cot AC$, a table of natural cotangents enables a numerical example to be solved rapidly. Usually $p=q=1$, and the equation reduces to $n\cot AD=(n-m)\cot AB+m\cot AC$.—L. J. **Spencer**: Crystals of iron phosphide (rhabdite) from a blast-furnace. The small, acicular, tin-white, and strongly magnetic crystals were found sparingly in cavities in a large mass of metal at the bottom of a blast-furnace near Middlesbrough. They are tetragonal (sphenoidal-hemihedral) with the axial ration $a:c=1:0{\cdot}3469$.—Dr. G. T. **Prior**: The meteoric stone of Cronstad, Orange Free State.

Royal Meteorological Society, November 17.—Major H. G. Lyons, president, in the chair.—J. S. **Dines**: The mounting and illumination of barometers and the accuracy obtainable in the readings. The author described the method of mounting and illuminating the barometer in accordance with the plan adopted at the Meteorological Office, South Farnborough. This consisted in hanging the barometer against a window, with a thin wooden screen, 6 in. wide, placed behind it about 1 in. from the tube. In this screen was a narrow slit ¾ in. wide, which came immediately behind the top of the mercury column, and admitted light from the window. The opening in the screen was covered with a piece of ground glass or thin paper, which prevented the passage of direct sunlight and gave a diffused illumination in all circumstances. Another feature of the mounting was the clamping of the bottom of the tube as was generally done in the case of instruments of the Fortin type, in order to prevent swinging of the barometer. The paper also contained an account of several sets of comparative readings of the barometer taken by different observers and between different types of instruments, which showed a remarkably close agreement with one another. The prevalent habit of tapping the instrument before reading was not considered desirable.—N. A. **Comissopulos**: The seasonal variability of rainfall over the British Isles. This paper dealt with a method of presenting rainfall statistics brought forward the year previously by Dr. H. R. Mill and Mr. C. Salter in a paper entitled "Isomeric Rainfall Maps of the British Isles." The author has treated the paper in a slightly different manner from the methods in the paper he has discussed, and has made use of the standard deviation as a measure of variability. The conclusions relating to the distribution of rainfall which arise from this method of discussion are the same as those given by the isomeric maps.

PARIS.

Academy of Sciences, November 15.—M. Ed. Perrier in the chair.—T. H. **Gronwall**: Minimum surfaces forming a family of Lamé.—Léon **Bouthillion**: The application to wireless telegraphy with sparks of the method of charging condensers by dynamos of constant E.M.F.—Albert **Colson**: Heats of equilibrium and the law of saturated solutions.—Paul **Bary**: The velocity of solution of liquids in india-rubber. The experimental results of G. Flusin are shown to be exactly represented by a simple formula.—Emile **Saillard**: The action of copper solutions on saccharose. The estimation of invert-sugar in presence of saccharose.—F. **Kerforne**: The presence of mylonites at the base of the Cambrian at the south of Rennes.—J. **Repelin**: New observations of the tectonic of the north-east portion of Basse Provence.—Henri **Coupin**: The ferment action of marine bacteria. Forty-three species of bacteria of marine origin have been studied from the point of view of their action on sugars and starches. Only four species caused no fermentation, and twenty-eight out of the forty-three fermented glucose.—M. **Marage**: Treatment of loss of speech resulting from shock. Loss of speech is frequently caused by the explosion of shells of large calibre, without any apparent lesions, and this is frequently accompanied by deafness. Details of treatment are given for five cases.—G. A. **Le Roy**: Waterproofing military cloths and fabrics. The materials are treated with solutions of sodium aluminate, dried, and then passed through a bath of weak acetic or formic acid. The material thus treated is waterproof, but not impervious to air.—R. **Kœhler**: Description of a new species of Astrophiura.—A. **Vayssière**: The Eupteropods collected during the scientific expeditions directed by S.A.S. the Prince of Monaco.—Mlle. Janina **Wiszniewska**: Anti-phenol serum. In certain fermentative processes in the intestine a specific substance is produced, always producing by injection into animals definite lesions. Although behaving like a phenol with the reagents used for detecting phenols, it is distinct from oxy-phenylacetic acid or other known phenol derivatives. By injecting this substance into the horse, an anti-body is produced in the serum of the animal, and this neutralises the antigen, both *in vitro* and in guinea-pigs, rabbits, and dogs.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 11, vol. i.).—R. G. **Harrison**: Experiments on the development of the limbs in Amphibia. At the time of appearance of the tail bud, the anterior limb of Amblystoma is already determined in the mesoderm cells of that region of the body-wall which lies close to the pronephros and ventral to the third, fourth, and fifth myotomes. The prospective significance of this

group of cells as a whole thus is defined some time before differentiation becomes visible.—C. G. **Bull**: A mechanism of protection against bacterial infection. Bacteria circulating in the blood are quickly removed when they are agglutinated or clumped, and the clumps deposited within the organs are taken up by phagocytes and digested. They appear not to be destroyed by solution or lysis through the operation of serum constituents of the blood.—C. A. **Kofoid** and Elizabeth B. **Christiansen**: The life-history of Giardia. *Giardia muris* and *Giardia microti* produce a readily recognisable enteritis in mice, and both binary and multiple fission take place in the free non-encysted stage. There is no Octomitus stage. The morphological characters separate six species. The parasite in mice appears to be distinct from that in man.—F. W. **Clarke** and W. C. **Wheeler**: The stony corals have been repeatedly analysed and with generally concordant results. Thirty analyses here made have confirmed the older data. The object of the investigation is to determine what each group of organisms contributes to the formation of marine limestones. The highest proportions of calcium phosphate are commonly associated with high values for magnesia.—C. R. **Stockard**: An experimental analysis of the origin and relationship of blood corpuscles and the lining cells of vessels. Vascular endothelium erythrocytes and leucocytes, although all arise from mesenchyme, are really polyphyletic in origin; that is, each has a different mesenchymal anlage.

BOOKS RECEIVED.

Scientific Ideas of To-day. By C. R. Gibson. Fifth edition. Pp. 344. (London: Seeley, Service and Co., Ltd.) 5*s*. net.

Mathematics for Machinists. By R. W. Burnham. Pp. viii+229. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

Determinative Mineralogy, with Tables for the determination of Minerals by Means of their Chemical and Physical Characters. By Prof. J. V. Lewis. Pp. vii+155. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

Properties of Steam and Ammonia. By Prof. G. A. Goodenough. Pp. vii+108. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

Wisconsin Geological and Natural History Survey. Bulletin No. xlv. Economic Series. No. 20: The Peat Resources of Wisconsin. By F. W. Huels. Pp. xvii+274. (Madison, Wis.)

Tuberculosis: a General Account of the Disease, its Forms, Treatment, and Prevention. By Dr. A. J. Jex-Blake. Pp. viii+231. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 25.

ROYAL SOCIETY, at 4.—Special General Meeting to receive the Annual Report of Council: at 4.30.—The Measurement of the Rate of Heat Loss at Body Temperature by Convection, Radiation and Evaporation: M. Flack, O. W. Griffith and L. Hill.—The Growth of the Body in Man; The Relationship between the Body Weight and the Body Length (Stem Length) E. W. A Walker.—The Rate of Absorption of Various Phenolic Solutions by Seeds of *Hordeum vulgare* and the Factors Governing the Rate of Diffusion of Aqueous Solutions across the Semi-permeable Membranes: Prof. A. J. Brown and F. Tinker.—The Controlling Influence of Carbonic Dioxide. Part III. The Retarding Effect of Carbon Dioxide on Respiration: F. Kidd.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some Difficulties of Design of High-speed Generators: Prof. A. B. Field.

OPTICAL SOCIETY, at 8.—The Influence of Visual Errors in Musketry: J. H. Sutcliffe.

FRIDAY, NOVEMBER 26.

PHYSICAL SOCIETY, at 5.—Obtaining and Maintaining a Bright Hydrogen Spectrum, with special reference to the 4341 Line: J. Guild.—Determination of the Coefficient of Diffusion of Potassium Chloride by an Analytical Method Dr. A. Griffiths.—Apparatus for Evaluating Elliptic Integrals: A. F. Ravenshear.

MONDAY, NOVEMBER 29.

ROYAL SOCIETY OF ARTS, at 4.30.—Optical Glass: Dr. W. Rosenhain.

MEDICAL SOCIETY, at 8.30.—Gas Poisoning: Physiological Symptoms and Clinical Treatment: Dr. Leonard Hill.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Railway Development of Africa, Present and Future: Sir Charles Metcalfe, Bart.

TUESDAY, NOVEMBER 30.

ROYAL SOCIETY OF ARTS, at 4.30.—Recent Developments in Jamaica; Internal and External: Sir Sydney Olivier.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Harbour and Coast-Defence Works at Alexandria: D. E. Lloyd-Davies.—Galvan Port, Bahia Blanca, Argentine: C. A. Trery.

WEDNESDAY, DECEMBER 1.

ROYAL SOCIETY OF ARTS, at 4.30.—Insects and War: Dr. A. E. Shipley.

GEOLOGICAL SOCIETY, at 5.30.—The Petrological Microscope; New or Little-known Methods and Accessories: Dr. J. W. Evans.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Microchemistry of some Alkaloids: Dr. G. D. Lander.—The "Presumptive Coli Test" on Unchilled Water: W. Partridge: Notes on Methods of Analysing Oleaginous Seeds and Fruits: E. R. Bolton.

THURSDAY, DECEMBER 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Note on the Existence of Converging Sequences in certain Oscillating Successions of Functions: W. H. Young.—The Emulsifying Action of Soap; a Contribution to the Theory of Detergent Action: S. A. Shorter and S. Ellingworth.—The Newtonian Constant of Gravitation as affected by Temperature: P. E. Shaw.—Skin Friction of the Wind on the Earth's Surface: G. I. Taylor.

FRIDAY, DECEMBER 3.

GEOLOGISTS' ASSOCIATION, at 7.30.—Some Features of the Antarctic Ice: J. D. Falconer.

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